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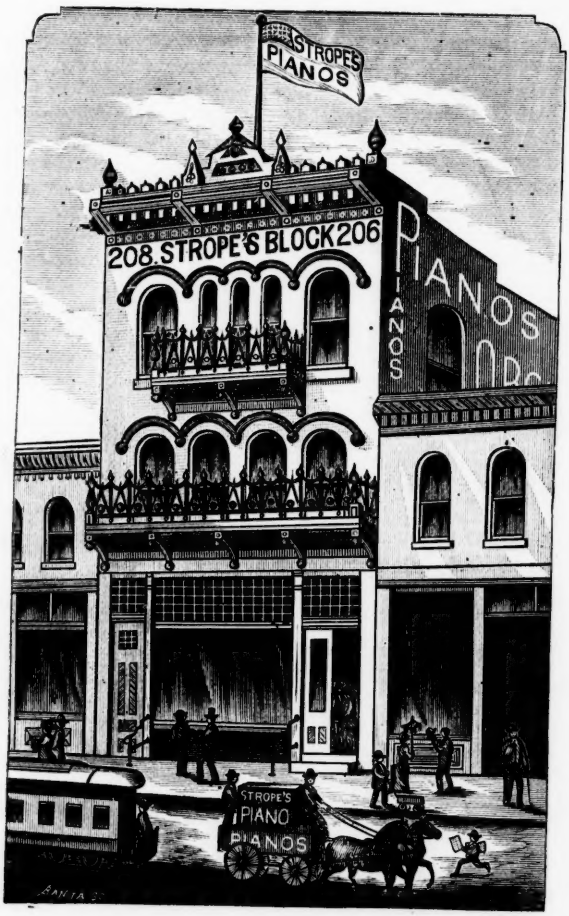

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KANSAS CITY

REVIEW OF SCIENCE AND INDUSTRY,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND LITERATURE.

VOL. VIII. OCTOBER, 1884. NO. 6

PROCEEDINGS OF SOCIETIES.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—PHILADELPHIA MEETING.

REPORTED BY PROF. E. H. S. BAILEY.

The general sessions of the Association were held in the Academy of Music. Thursday was largely spent in the usual routine work of organization. In the evening Prof. Newberry, of Columbia College, delivered an illustrated lecture upon the subject, "The Geological Evolution of the North American Continent." At the general session on Friday morning the subject of an Inter-National Scientific Congress was thoroughly discussed. Both British and American scientists strongly favor the movement. In the evening the citizens of Philadelphia tendered a reception to the members of the British and American Associations. Hon. John Welsh, of Philadelphia, delivered an address of welcome, followed by Dr. Pepper, of the University of Pennsylvania. Prof. Young, of Princeton College, the retiring President of the American Association, read the annual address upon "The Pending Problem of Astronomy." The subject was discussed in his well known masterly manner. Dr. Ball, of Ireland, being called upon responded in a three minute speech, winning the good opinion of the audience. The remainder of the evening was devoted to an informal promenade and partaking of the generous lunch provided.

On Saturday, there being no session of the Association, the members were at liberty to join any of the excursions given by different railroad companies.

Many went to Long Branch where a reception was tendered them by Past-President Isaac Lea; others went to Atlantic City, and others to Cape May, where they were entertained at Congress Hall. Many, especially of the foreign members, visited the anthracite coal regions, while the botanists visited the pine barrens of New Jersey.

On Monday morning at the general session reports were read from a number of special committes. After work during the day in the special sections, the members in the afternoon and evening visited the Zoölogical Gardens, the reception at the Woman's Medical College and that tendered by the Faculty of the University of Pennsylvania.

Professor Robert S. Ball delivered a thoroughly scientific lecture on Tuesday evening upon "The Distance of the Stars." A reception given at the Pennsylvania Academy of Fine Arts followed the lecture. This really artistic building was beautifully decorated with flowers and vines, and the reception was perhaps he most brilliant of the session.

Wednesday afternoon was devoted to a reception at Haverford College, and on Thursday evening the exercises closed. The meeting was of particular interest on account of the presence of so many distinguished foreigners. Several other scientific societies met in the city at the same time. Over 1,200 members were present, and nearly 500 new members were elected.

The following officers were elected for next year:

President.—Prof. H. A. Newton, of Yale.

Vice-Presidents.—Section A—J. M. Van Vleck, Middletown, Conn. Section B—Professor C. F. Brackett, Princeton College. Section C—William R. Nichols, Boston. Section D—Professor J. Burkitt Webb, Cambridge. Section E—Professor Edward Orton, Columbus, O. Section F—Professor B. G. Wilder, Cornell University. Section G—Professor S. H. Gage, Cornell University. Section H—Professor William H. Dall, Washington. Section I—Professor Edward Atkins, Boston.

Permanent Secretary.—Professor F. W. Putnam, Cambridge (re-elected).

General Secretary.—Charles Sedgwick Minot, Boston.

Assistant General Secretary.—C. C. Abbott, Trenton.

Secretaries of the Sections.—A—E. W. Hyde, Cincinnati. B—Professor A. A. Michelson, Cleveland. C—Professor F. P. Dunnington, University of Virginia. D—C. J. H. Woodbury, Boston. E—Professor H. Carvill Lewis, Philadelphia. F—M. C. Fernald, Maine. G—W. H. Walmsley, Philadelphia. H—Mrs. Erminnie A. Smith, New Jersey. I—J. W. Chickering, Washington.

The next meeting will be held in Bar Harbor, Maine, or Ann Arbor, Mich.

The following are the titles of some of the papers read:

Section A (Mathematics and Astronomy) met in Room 1, Horticultural Hall. Vice-President H. T. Eddy, of Cincinnati, was in the chair, and G. W. Hough, of Chicago, acted as secretary. The papers presented, as was the case in all the sections, were not all read, there not being sufficient time. Following is a list of the papers:

Results of observation and experiment with an "Almacantar" of four inches aperture, at the Harvard College, S. C. Chandler, Jr. On the colors of variable stars, S. C. Chandler, Jr. Colors of the stars, E. C. Pickering. Temporary stars, Daniel Kirkwood. A criterion for the rejection of doubtful observations, Mansfield Merriman. On the magnitude of the errors which may be introduced in the reduction of an observed system of stellar co-ordinates to an assumed normal system by graphic methods, William A. Rogers. Systematic errors in stellar magnitudes, E. C. Pickering. The average asteroid orbit and the asteroid ring, M. W. Harrington. On the original graduation of the Harvard College meridian circle, *in situ*, William A. Rogers and George A. Clark. To exhibit and describe a model of the ruled cubic surface known as the cylindroid, Robert S. Ball. The geodetic work of the United States Coast and Geodetic Survey, J. Howard Gore. The lunar aurora, John Haywood. Micrometric observations of Jupiter's third satellite, David P. Todd. On the course of the corrections to the heliocentric longitudes of Newcomb's tables of Uranus and Neptune, David P. Todd. Mechanical arithmetic illustrated by the averaging machine, W. S. Auchincloss. Analysis of the formula for the Moon's latitude as effected by the figure of the Earth, John N. Stockwell. The products of vectors, Samuel Emerson. On an indirect solution of the equation $a = ac + \frac{d_a}{dt} + \frac{1}{2}\frac{d^2_a t^2}{dt^2} + \frac{1}{2} 3 \frac{d^3_a t^3}{d_r{}^3}$ ac. to the sixth power of the time, in which $\frac{d_a}{dt}$ is a function of four variables, William A. Rogers. Description of the Leander McCormick observatory of the University of Virginia, Ormond Stone. On the visibility of faint objects under red illumination, G. W. Hough. A brief account of some preliminary experiments in the construction of clocks of precision, Leonard Waldo. A collection of formulæ for the area of a plane triangle, Marcus Baker. The nebulæ, Lewis Swift. On the fundamental formula of statistical mechanics, with applications to astronomy and thermo-dynamics, J. Willard Gibbs. On the rotation of a rigid system in four-dimensional space, Irving Stringham. A geometrical interpretation of the linear bi-lateral quaternion equation, Irving Stringham. A new apparatus for the study of Bayle's law, Leroy C. Cooley. On the mean temperature of the two hemispheres of the earth, H. Hennessy. On the constitution of the earth and planets, H. Hennessy. On an international standard for measurements, H. Hennessy. Linear functions of points, lines and planes, E. W. Hyde. Late researches on the solar surface with special reference to evanescent spots, S. I. Perry. Harmonic motion in stellar systems, Pliny Earle Chase.

Section B (Physics) assembled in the chapel of the Episcopal Academy. John Trowbridge, of Cambridge, Mass., acted as chairman and N. D. C. Hodges, of Salem, Mass., as secretary. The papers presented were:

On the Fritts' selenium cells and batteries, Charles E. Fritts. Relation of the electromotive force of a Daniell cell and the strength of the zinc sulphate solution, H. S. Carhart. Note on the periodic modification of electrostatic in-

duction, H. S. Carhart. Description of a Galvanometer for demonstrating the internal current transmitted through the liquid within a Voltaic cell, Conrad W. Cooke. On the variation of the resistance of Carbon under pressure, T. C. Mendenhall. Determination of the co-efficient of the speculum metal used for Professor Rolan's grating, William A. Rogers. Additional observations confirming the relation: Metre des archives=Imperial yard plus 3.37027 inches, William A. Rogers. A spectrophotometric study of pigments, Edward L. Nicolls. On the sensitiveness of the eye to colors of a low degree of saturation, Edward L. Nicolls. Sensitiveness of photographic dry plates, William H. Pickering. Photography of the infra-red region of the spectrum, William H. Pickering. Method for practical examination of railway employees as to color-blindness, acuteness of vision and hearing; with the results obtained by it, on the Pennsylvania Railroad, William Thomson. Upon a generator in use at Cornell University for producing oxygen and hydrogen gas by means of the dynamo machine, William A. Anthony. Thunderstorms and their relations to "low," Henry A. Hazen. A method of distributing weather forecasts by means of railroad trans, etc., John A. Miller. Thermal belts, J. W. Chickering, Jr. Notes on aneroids, M. W. Harrington. Some relations of positive and negative electricity, H. W. Eaton. On the magnetic rotation of the equipotential lines of electric currents in various metals and alloys, Edwin H. Hall. A proposed method of determining the magnetic dip by means of a magnetic pendulum, Marcus Baker. A possible method of electrical communication between vessels at sea, A. Graham Bell. Description of a galvanometer for demonstrating the internal current transmitted through the liquid within a voltaic cell, Conrad W. Cooke. An absolute Sensitomer, G. W. Hough. Notes on acoustics, Charles R. Cross. On a proposed method of ascertaining the least number of vibrations necessary to determine pitch, Charles R. Cross. On the formulæ for spherical refraction and thick lenses, James Loudon. On the distribution of potential in conductors experiencing the electromagnetic effects discovered by Hall, Sir William Thomson. On a standard galvanometer, S. P. Thompson. On the government of electric motors, S. P. Thompson. A preliminary note on the action of acids upon iron in the magnetic field, E. L. Nicolls. On a proof contact theory of electricity, A. E. Dolbear. On comparative cost electric light and oxy-calcium light, A. E. Dolbear. Electric discharges in relation to the equilibrium of gaseous atmosphere, James Dewar. First steps toward a general system of observations of atmospheric electricity, C. Abbe. Organization of seismological observations, C. Abbe. Methods of varifying weather probabilities, C. Abbe. Standards of barometry and thermometry, C. Abbe. The Princeton Meteorological Observatory, Wm. Libbey, Jr. Local and topical weather cards, W. M. Davis. Change in rainfall of Virginia, J. R. Purdie. An experiment for illustrating the conversion of mechanical energy into heat, C. E. Monroe. A form of apparatus for determinig the diathermacy of air and gases. J. R. Paddock. On the intensity of sound: the energy used by an organ pipe, C. K. Wead.

Section C (Chemistry) held its meetings in the chemical lecture-room of the

Episcopal Academy. John W. Langley, of Ann Arbor, Mich., was chairman and Henry Carmichael, of Brunswick, Maine, secretary. A list of the papers is appended:

On chloroproprionic acid and certain substituted acrylic and proprionic acids, C. F. Mabery. Torsion balances, Alfred Springer. Anhydrobenzoamidosalicyclic acid, Charles W. Dabney. Continuous etherification, L. M. Norton and C. O. Prescott. Analysis of a mural efflorescence, C. E. Monroe. The chemistry of roller milling, Clifford Richardson. On the chemistry of fish, W. O. Atwater. Examination of methods proposed for rendering the lighter petroleum oils inexplosive, C. E. Monroe. A new form of gas regulator, F. P. Dunnington. Notes on Remsch's test, Henry Leffmann. Discussion on Valence, to be opened by E. W. Clarke. Modification of Ruffles, method for the absolute determination of nitrogen, H. C. White. Optical method of estimating sugar in milk, H. W. Wiley. A preliminary report on the composition of the coals of Kansas, E. H. S. Bailey. Discussion—Educational methods in laboratory practice and in the illustration of chemical lectures, opened by Ira Remsen. Fermentation without combined nitrogen, Alfred Springer. On the assimilation of atmospheric nitrogen by plants, W. O. Atwater. An explanation of Gladstone and Tribe's "2—3 law in chemical dynamics," John W. Langley. Preliminary analysis of the bark of Fouquieria splendens, Engel, Helen C. De S. Abbott. The density of solid carbonic acid, James Dewar. On a substitute for litmus, John Fred. Heyes. Some observations on the phenomena of deliquescence, C. E. Monroe. Methods of milk analysis, Albert N. Leeds. Simple lecture illustrations, F. P. Dunnington. Production of argentic hydrate, F. P. Dunnington. Improvements in apparatus for rapid gas analysis, Arthur H. Elliott. Anthrocene from water gas tar, Arthur H. Elliott.

Section D (Mechanical Science and Statistics) occupied Room 2, Horticultural Hall, and with R. W. Thurston, of Hoboken, N. J., in the chair, and J. Burkitt Webb, of Ithaca, at the secretary's table, turned its attention to the following:

Steam engine practice in the United States, J. C. Hoadley. The strength of cast iron, W. J. Millar. Three problems of river physics, J. B. Johnson. Topography of machines, Oberlin Smith. Driven wells, J. C. Hoadley. Training for mechanical engineers, George J. Alden. Heating from a central source, Frederick Bramwell. Giant's Causeway and Portrush Electric Railway, W. A. Trail. On a new method of producing screws of standard length and uniform pitch, William A. Rogers. The production of optical surfaces, John A. Brashear. Irregularity in railroad building a chief cause of recent business depressions, William Kent. Electric tramways, M. H. Smith. Economy of the electric light, A. Stirling. Dillon's automatic sounder, Mr. Dillon. Dillon's flood regulator, Mr. Dillon.

Section E (Geology and Geography) held its sessions in the main Horticultural Hall. N. H. Winchell, of Minneapolis, presided, Eugene A. Smith, of

Tuscaloosa, Ala., performing the duties of secretary. The papers handed in were:

The geological age, character and origin of the gypsum beds of Cayuga County, N. Y., S. G. Williams. The correlation of the lower coal measures of Ohio and Eastern Kentucky, Edward Orton. On a section of the strata of cretaceous and tertiary formations of Alabama, Eugene A. Smith and L. C. Johnson. On some fish remains recently discovered in the silurian rocks of Pennsylvania, E. W. Clayple. The horizons of petroleum and inflammable gas in Ohio, Edward Orton. A review of the geology of Delaware, results of a survey now in progress, Frederick D. Chester. The salt-well at Humboldt, Minn., N. H. Winchell. An attempt to determine the amount of chemical erosion taking place in the limestone (calciferous to Trenton) valley of Centre County, Penn., and hence applicable to similar regions throughout the Appalachian system, A. S. Ewing. Deep-sea sounding in the Carribbean Sea, J. R. Bartlett, Navy Department, Washington, D. C. On the relative level of the Atlantic Ocean and Gulf of Mexico, with remarks on the Gulf Stream and deep-sea temperatures, J. E. Hilgard. Recent improvement in apparatus and methods of sounding ocean depths, Daniel Ammon. Notice of a new and important work on the origin of the crystalline schists, by Dr. I. Lehman, George H. Williams. The Second Geological Survey of Pennsylvania, Charles A. Ashburner. A brief account of the remarkable explorations in Thibet, Mongolia and the frontiers of India and China, receptly made by Kreshna, or A. K., a native surveyor, trained under the Trigonometrical Survey of India, with official map, Trelawney Saunders. New identifications in Biblical Geography, based on the recent survey of Western Palestine, made for the Palestine Exploration Fund, with the great map of the survey, and the reduced map of the Old Testament, Apocrypha and Josephus, derived therefrom, Trelawney Saunders. On the intimate relations of the Chemung and Waverly Groups in the northwestern portions of Pennsylvania and southwestern part of New York, James Hall. On the Eurypteridæ of the Devonian and Carboniferous systems of the United States, with a supplementary note on a species of Stylonurus, James Hall. British earthquakes and their seismic relations, Richard Owen. Sketch of life and scientific work of Dr. Arnold Guyot, William Libbey, Jr. Geographic classifications, illustrated by a study of plains, plateaus and their derivatives, W. M. Davis. On the ultimate results of converting the basin of the Desert of Sahara into an inland lake, P. H. Vander Weyde. Note on Cassiterite from King's Mountain, N. C., Charles W. Dabney, Jr. North Carolina phosphates, Charles W. Dabney, Jr. Native antimony from York, Prince William County, N. B., George F. Kunz. A great trap dyke across southeastern Pennsylvania, H. Carvill Lewis. A study of one point in the archæanpalæozoic contact line in southeastern Pennsylvania, Persifor Frazer. Geographical and physical conditions as modifying fossil faunas, H. S. Williams. On some large and peculiar fossil fishes from Ohio and Indiana, J. S. Newberry. On the geological survey of New Jersey, George H. Cook. The profile of Nicaragua, geographical and commercial, Captain Bedford Pim, R. N. The

pilot chart of the North Atlantic Ocean, J. R. Bartlett, Navy Department. Metamosphism in the Huronian of the Northwest, R. D. Irving. Identification of the Green Mountain gneisses in Eastern New England, C. H. Hitchcock. Occurrence of builders of decomposition in gneiss at Washington, D. C., J. W. Spencer. A study of "Eozoon Canadense," Alexis A. Julien. Evidences of local glaciers in the Catskill Mountain region, John C. Smock. Sand boulders in drift at Columbia, Mo., J. W. Spencer. The Missouri coteau and its moraines, J. E. Todd. Course of motion in glaciers, Charles Whittlesey. The genesis and conservation of volcanic enery, J. W. Pike. Exhibition of a geological map of the United States, and a geological map of New York, New Jesery and Pennsylvania, J. W. Powell. On the phpsical condition of the interior of the earth, H. Hennessy. Musical sound, its wide distribution and properties, H. C. Bolton. Musical sand: its wide distribution and properties, H. Carrington Bolton and Alexis A. Julien. Notice on the micoscopical examination of a series of ocean, lake, and desert sands, Alexis A. Julien and H. Carrington Bolton. On the erosive action of the ice, J. S. Newberry.

Section F (Biology) transacted business in the hall of the Union League. E. D. Cope, of Philadelphia, was chairman, and C. E. Bessey, of Ames, Iowa, secretary. The papers were:

On Tenecanthus and Gyracanthus from the Chemung of Pennsylvania, E. W. Claypole. Some observations on the influence of oxygenated and un-oxygenated blood, as well as of blood in various degrees of dilution on the isolated heart of the frog and terrapin, H. G. Beyer. Affinities of Dionæa, Joseph F. James. Biological problems, C. S. Minot. A botanical study of the mite-gall found on the petiole of *Juglans nigra*, known as *Erineum anomalum:* Schw., Lillie J. Martin. The habits of some Arvicolinæ, Edgar R. Quick and A. W. Butler. The existence and dorsal circumscription of the port Æ (foramen and Monro) in the adult human brain, Burt G. Wilder. The relative position of the cerebrum and the cerebellum in anthropoid apes, Burt G. Wilder. Observation on the phylogony of the artiodactyla mammalia, derived from American fossils, E. D. Cope. The torsion of leaves, W. J. Beal. The fossil flora of the globe, historical view, Lester F. Ward. The fossil flora of the globe, geological view, Lester F. Ward. The fossil flora of the globe, botanical view, Lester F. Ward. Influence of isolation upon vegetation, E. Lewis Sturtevant. The osteology of oreodon, W. B. Scott. Vesiculæ seminales of the Guinea pigs, C. S. Minot. A new parasitic Copepode from the clam (Mya arenaria), R. Ramsay Wright. The influence of cross fertilization upon the development of the strawberry, William R. Lazentey. Experimental research relating to the etiology of tuberculosis, George M. Sternberg. On the extinction of species, Thomas Meehan. Preliminary note on the lymphatics of the common bull-head (*Amiurus catus*), F. L. Kilborne and S. H. Gage. On the nervous system of Comatula with observations on the mutual affinities of the recent group of Echinoderms, A. Milnes Marshall. Stomates on seeds, George Macloskie. Structure and development of suspensory ligament in the horse, ox and sheep, D. J. Cunningham. Ethidene dichloride as an anæs-

thic, John G. McKendrick. On the hitherto unknown mode of oviposition in the Carabidæ, C. V. Riley. Preliminary notes on the delicacy of the special senses, E. H. S. Bailey and E. L. Nichols. The adventitious inflorescence of curcuta glomerata, C. E. Bessey. On a special function of the external third of the lenticular nucleus of the corpus striatum, Charles Porter Hart. Observations upon the amphibia brain, from a comparison of amphiuma, menopoma, menobranchus, Henry F. Osborne. Fertility in hybridization, R. B. Roosevelt. On tbe skin of insect, C. S. Minot. Hibernation of the lower vertebrates, A. W. Butler. The develoyment of limulus, J. S. Kingsley. Do the cerebellum and oblongata represent two encephalic segments or only one? Burt G. Wilder. On the morphology and evolution of the tail of osseous fishes, John A. Ryder. On the mammalian affinities of the saurians of the Peruvian epoch, Edward D. Cope. The hood of the hooded seal (Cystophora cristata), C. Hart Merriam. Remarks of delegates from the *Ornithologischer verein in Wein*, C. Hart Merriam. Polarity of leaves of Erigeron Canadense, W. J. Beal. On some points in the development of pelagic teleostean eggs, George Brook, Jr. The dynamics of the insect crust, George Macloskie. Some questions in anatomical nomenclature, Burt G. Wilder. Experimental researches on the so-called thought transference, L. F. Barrett. Alleged sensory effects of magnetism, L. F. Barrett. On the finger-muscles in *Megaptera longimana*, and other whales, John Struthers. On the presence of eyes and other sense organs on the shells of chitonidæ, H. N. Moseley. Utricularia vulgarus with young teleostean fishes entrapped in the bladder-traps of that plant, H. N. Moseley. Feathers of the Dodo, H. N. Moseley. Larval theory of the origin of tissue, Alpheus Hyatt. Objections to some commonly accepted views of heredity, Alpheus Hyatt. Structure and affinities of Beatricea, Alpheus Hyatt. Structure of the siphon in the Endoceratidæ, Alpheus Hyatt. Researches on growth and death, Charles S. Minot.

Section G (Histology and Microscopy) spent the day in the hall of the College of Physicians. T. G. Wormley, of Philadelphia, presided and Romyn Hitchcock, of New York City, acted as secretary. Following are the papers:

Methods of cultivating micro-organisms, George M. Sternberg. Remarks on fluid and gelatinous media for cultivating micro-organisms, with description of Salmon's new culture tube and demonstration of the method of using it, R. Hitchcock. On the reproduction of short standards of length, William A. Rogers. On some new microscopic devices, R. H. Ward. Recent studies on the theory of the microscope, and their practical results as regards the use of the microscope in scientific investigations, R. Hitchcock. On some points in microtomy, John A. Ryder. Upon a microscopic method of studying the amphibian brain, Henry F. Osborne. Histology of Lingula, H. G. Beyer. Description of the Schroder camera lucida, R. Hitchcock. Demonstrations of perforations in the cellulose walls of plant-cells, Louis Elsberg. Electric illumination for microscope, with practical illustration, W. H. Walmsley. Celloidine as an imbedding mass, Wm. Libbey, Jr. An immersion apparatus for the determination of the temperature of the critical point in the fluid cavities of minerals, A. A. Julien.

Section H (Anthropology) was called to order in the Foyer of the Academy of Music. E. S. Morse, of Salem, Mass., was chairman, and G. H. Perkins, of Burlington, secretary. The following papers were received:

Uses of the emblematic mounds, Stephen D. Peet. The lineal measures of the semi-civililized nations, D. G. Brinton. The sacred pipes of friendship, Frank La Flesche. Some observations upon the usage, symbolism and influence of the sacred pipes of fellowship among the Omahas, Alice C. Fletcher. Notes upon some quartz objects from Central Minnesota, Miss F. E. Babbitt. The importance of the study of primitive architecture to an understanding of the prehistoric age in America, Stephen D. Peet. Local weather lore, Amos W. Butler. Some characteristics of the Indian earth and shell-mounds on the Atlantic Coast of Florida, Andrew E. Douglass. The manner in which Indians made their stone implements, P. R. Hoy. Disputed points concerning Iroquois pronouns, Erminnie A. Smith. Remarks on North American races and civilization, E. B. Tylor. Upon the evolution of a race of deaf mutes in America, A. Graham Bell. The occurrence of man in the upper miocene of Nebraska, E. D. Cope. The use of the plough in Japan, Edward S. Morse. The three culture periods, J. W. Powell. A search in British North America for lost colonies of Northmen and Portuguese, D. G. Haliburton. The sacrificial stone of San Juan Teotihuacan, A. W. Butler. Eastern archery, Edward S. Morse. Formation of Iroquois words, Erminnie A. Smith. The different races who built mounds in Wisconsin, Stephen D. Peet. Evolution of animal life illustrated by study of emblematic mounds, Stephen D. Peet. Etymology of the Iroquois word Rha-wen-ni-yu, Erminnie A. Smith. Description of the skeletons and skulls found in the large mound of the Turner Loup, Ohio, Cordelia A. Studley. Mythology of the Wintuns, J. W. Powell. Interviews with a Korean, Edward S. Morse. Some parallelism in the evolution of races in the old and new world, Daniel Wilson. On the geographical distribution of labretifery, W. H. Dall. On the identification of the animals and plants of India which are mentioned by ancient Greek authors, V. Ball. The comparative longevity of the sexes, Mrs. A. B. Blackwell.

Section I (Economic Science and Statistics) was quartered in the hall of the the Historical Society, with John Eaton and C. W. Smiley, of Washington, D. C., as chairman and secretary respectively. The papers were:

The principles of graphic illustration, Franklin B. Hough. On the credit of the United States Government, E. B Elliott. The future of the United States, John Biddulph Martin. The structure and economic value of some of our woods (Illustrated), P. H. Dudley. Some experiments in a new method of land cultivation by the use of dynamite and the important results obtained, George W. Holley. The apprenticeship question and industrial schools, Thomas Hampson. Lands in severalty to Indians, illustrated by experiences with the Omaha tribe, Alice C. Fletcher. Condition of deaf mutes and deaf mute instruction in the United States, statistically considered, J. W. Chickering, Jr. Production and distribution, Edward Atkinson. Upon the expediency of a proposed "new departure" in the form of schools for the education of deaf mutes, Joseph C. Gor-

don. On indexing the literature of science, B. Pickman Mann. Percentages and costs of nutrients in foods, W. O. Atwater. Brief outlines of the investigations upon the power to move railroad trains and the mechanical inspection of railroad tracks, as made by the dynagraph and track inspection car, P. H. Dudley. Irregularity in railroad building a chief cause of recent business depressions, William Kent. An account of the first general census of India, Trelawney Saunders. The uses of great expositions, Lyndon A. Smith. American production for American consumption, J. R. Dodge. A review of the proceedings of the section of economic science and statistics at the Montreal meeting, B. A. A. S., Chas. W. Smiley. Commercial relations of the United States with Spain and her colonies, his Excellency Don Arturo de Marcoartu. The American pearl, George F. Kunz The philosophy of criminal development, Lewis W. Haupt. An illustration of the results produced by the artificial propagation of fish, Chas. W. Smiley. The education of pauper children, industrially and otherwise, James O. Bevan. On technical education in the British Islands, Henry Hennessy. Natural scheme of high culture in the United States of America, Knut Forsberg. The learned professions and the public, 1870—1880, Chas. Warren. The aims and methods of manual training-schools, C. M. Woodward. On the application of the historical method to questions in economic science, T. B. Browning. A new resource for the women of the United States—silk culture, Loren Blodget. Some economic and social effects of machinery, Edward T. Peters. A discussion of the principles involved in the general action of vegetation and of trees especially to prevent extremes of temperature, James Hyatt. National identity in its economic aspect, Loren Blodgett.

THE BRITISH ASSOCIATION AT MONTREAL.

On August 27th the British Association for the Advancement of Science met at Montreal; the first instance since its organization, fifty-three years ago, that it has ever held a meeting outside of Great Britain. It is a notable association, not only from its present membership and the results of their labors, but also from the fact that it was formed principally through the efforts of such former scientific lights as David Brewster, Humphrey Davy, and John Herschel, whose associates and successors have made it the leading society of the world in all that pertains to science.

Among the distinguished members present from abroad were: Sir William Thomson, Prof. E. B. Tylor; the astronomer, Robt. S. Ball, of Dublin, Prof. Roscoe, Prof. Dewar, Captain Pitt, Sir Lyon Playfair, Prof. E. H. Schafer, Prof. William A. Tilden, Boyd Dawkins and others of note; while of the eminent scientists on this side of the water were: Principal J. W. Dawson, and Prof. T. Sterry Hunt, of Montreal, Professors Geo. F. Barker, Mendenhall, Rowland, Asa Gray, Putnam, Newbury, Youmans, Scudder, Minot, etc.

We are indebted to Professor J. D. Parker, U. S. A., for copies of news-

papers containing reports of the proceedings and for the use of his letters to the Kansas City *Journal* which we use freely for the benefit of our readers:

"This is really the British congress of science, and is a large and powerful body of men. Montreal is full of English professors, with a multitude from all portions of the continent. Members of the American Association for the Advancement of Science have been made corresponding members, and we have delegations of professors from all parts of the United States. The meeting has also brought together many notables in the political and business world.

"Professor Cayley, LL.D., F. R. S., the retiring president, is absent, and Sir William Thomson gave the address of the retiring president. Sir William Thomson was a second wrangler at Cambridge, and is one of the leading electricians in the world. He has published a great variety of papers, making important contributions to his department. and on the completion of the Atlantic cable in 1866 was knighted and presented with the freedom of the city of Glasgow. The English Government and institutions of learning have showered down upon him about all the honors and degrees possible, and he seems to be worthy of them.

"The first day was a notable one. During the morning hours the various sections were getting into working order. There are sections in mathematical and physical science, chemical science, geology, biology, geography, economic science and statics, mechanical science and anthropology. The papers read before these sections are from the most distinguished men in their several departments, and contain the most recent developments.

"At 4:30 P. M. there was a civic reception at Queen's Hall, when the mayor of Montreal, who wore his chain of office, gave the members of the Association a hearty welcome. The hall was crowded and the platform was full of distinguished men from England and America. Sir William Thomson acknowledged in cordial terms the hearty welcome extended by the mayor. Sir John A. McDonald, the premier, then came forward and addressed the meeting, making a very pleasant address of welcome in behalf of the dominion.

"In the evening Queen's Hall was filled to overflowing with an audience of gentlemen and ladies such as seldom convene in this country. As we looked upon the sea of upturned faces, a gentleman from this side of the water remarked: 'This is an opportunity of a lifetime.' His excellency the governor-general, Lord Lansdowne, Lady Lansdowne, and suite, were on the platform. Lord Lansdowne gave a most excellent address, which received frequent applause. The lord is a clever speaker in the English sense.

"Lord Rayleigh's address, the president elect, was the event of the evening. Lord Rayleigh is a very eminent man in the higher mathematics and physics. He gave a rapid review of science in his department of physics. He spoke very feelingly of the death of Sir William Siemens, who has occupied a very conspicuous place in the working of the Association and in the development of the dynamo machine. He was also actively engaged in many other inventions which have proved of great use. The address summed up the progress of science

in the departments touched in a comprehensive way. The lecturer spoke of the saturization of iron by magnetism, the resistance offered by the coil to the passage of electricity, the beautiful and mysterious phenomena attending the discharge of electricity in nearly vacuous spaces, the mechanical theory of heat, the dissipation of energy, the mechanics of viscous fluids, the friction of oiled surfaces, the nature of gaseous viscosity, the investigation of the spectrum, the visible and ultra-violet spectrum, the velocity of light, the telephone and phonograph, the scientific work of Maxwell, and the prospects of experimental science. Lord Rayleigh favored the modern tendency to give less Greek and Latin, and more German and French in our college courses. The address was loudly applauded, and I believe there is more applause in the British Association than in the American Association.

"Hon. Dr. Chauneau addressed the meeting in French, and spoke of the work which the Royal Society is doing in Canada. There were several other speakers during the evening.

"I see other visitors here from the West. Among them I notice Marcus Baker, of the United States Coast and Geodetic Survey, in charge of the Magnetic Observatory at Los Angeles, Cal. Prof. W. I. Stringham, Professor of Pure Mathematics in the California University, is also here.

"A general survey of the British Association of Science impresses one with the magnitude of the work which they are accomplishing. Fifty-two years since the society was organized has seen almost an entire revolution of science. Old theories have passed away and old beliefs have vanished. Sir William Thomson referred to the meeting of the Association where a physicist demonstrated that it would be impossible for a steamship to cross the Atlantic. But in spite of this demonstration the Association now finds itself on the other side of the Atlantic. These English savants are thoroughly in earnest in their scientific studies and researches. No expense, and no amount of time and study are spared to attain the results aimed at. The English scientist is a specialist in his chosen branch and knows all about it, although he may be a child in other things. One of the scientists asked another about the location of a certain room in the steamer, when the other scientist pulled out an elaborate plan of the ship, and pointed out the room to him.

"The work in the various sections is first-class. It is refreshing to hear papers read by the masters in science, whose books one has studied from his youth. Prof. Asa Gray is here, and is honored by the English scientists as the leading botanist, perhaps, in the world. They say there are a great many clever gentlemen in America, and seem to take pleasure in mentioning such names as Gray, Dana, Newcomb, Newberry, Bell and others. The old prejudice against American institutions has almost disappeared, and I believe this meeting of the leading scientists of Europe, in Canada, will result in much good to both countries.

"I have just returned from an excursion to Quebec, where 400 members of the Association enjoyed the hospitalities of the city to the fullest extent. The

trip was delightful. We were first entertained by the citizens, and then driven out to Spencer Wood, where the lieutenant-governor gave us a magnificent reception. In the evening Lord Lansdowne gave us the crowning reception, in the citadel on the heights overlooking the city. The English and Canadian scientists do not seem to have heard of prohibition. My cab party of English professors took so much wine that they became quite mellow. On our return down the heights the road was very steep and slippery from a recent rain, and we were obliged to get out and walk. It is amusing to see an English professor with a full line of titles trying to navigate down a steep road in a dark night, when his head is all in a whirl. There is a chance for prohibition work even in the English universities.

"My berth was also occupied by an Oxford professor. He came in after midnight in bad humor. First, some one had taken his umbrella, and then at Lord Lansdowne's party he had lost his McIntosh. It was amusing to hear him give the Canadians and Americans a blessing. He said there were a few 'clever' Americans, but it was a 'beastly' country. There was more real comfort in London than in all the world besides. One of the distinguished English scientists said their ship, in coming over, struck a whale and cut him clear in two! A lady at the table said that was a fish story.

"On Sunday our party was on the river, and we extemporized a devotional meeting on the steamer. About a hundred gathered around the piano, where we sang all the hymns we could remember. Several clergymen were present and addressed the meeting. The English sing some sweet hymns not common to this country. The company represented every phase of belief, but there was a religious fervor truly refreshing. As the old songs welled up and floated across the water reminding many of distant homes and loved ones, I could see the tears starting from many eyes. There is something in any common manhood that overshadows creeds and sects. Religion, pure, undefiled, touches the universal heart, and men from all lands melt together and find that they are common brothers.

"On the steamer I met a Japanese professor from Tokio University. He was sent by the Japanese Government, and graduated at Cambridge, England. He is a follower of Confucius, but said he loved the New Testament in English very much, but the Testament had been translated into such wretched Japanese that he could not understand it. It would be well for the foreign board to look after their Japanese translations. He has charge of the mathematics in the Tokio University, which the government supports at an expense of nearly $400,000 a year.

"The Association will adjourn next Wednesday, and there are many excursions made to places of interest in Canada and the United States. Several hundred of the members will take a free excursion to the Rocky Mountains.

"Some of the speakers in their addresses, referred to their seasickness in the ocean voyage. The mayor of Quebec said probably science would soon overcome this difficulty. Sir William Thomson said probably some way would

be discovered so members could be put to sleep and packed up for the ocean voyage, to awake at a certain day and hour in their various sections.

"Monday was a hurrying day in the British Association. Many important papers had been laid over for want of time, and other papers of equal interest were pressed upon the committees to be read and discussed. The closing days of the Association are always filled to overflowing, and this is especially true at this meeting. Eight sections and subsections are in full blast, and all the rooms are crowded.

"In the section of physical science, Prof. Schuster read a paper on the connection of sun-spots with terrestrial phenomena. He said that this connection was not established beyond a doubt. Observations have been made on this subject for fifty years. On the Rhine the good wine years are coincident with the least number of sun-spots. The greatest number of cyclones occur coincidently with maximum sun-spots. Small comets are more numerous also at the same time. Prof. Rowland showed that the variations in the sun's heat is due more to errors in observations than true change. Mr. W. Lant Carpenter said that the coincidence of maxima and minima of magnetic disturbances, auroral displays, average rainfall, etc., with sun-spots, in a period of eleven and one-tenth years, had long been observed.

"Professor Darwin, son of Charles Darwin, read a report on the harmonic analysis of tidal observations. He regretted that the admiralty is satisfied with the old methods of tidal reduction and has no intention of making any contribution to our tidal knowledge of instituting harmonic analysis of tidal records. The tides of the North German Ocean are now being reduced according to the harmonic methods by the imperial admiralty. Mr. Breson, in charge of the Natal Observatory, and Mr. Gill, Astronomer Royal at the Cape of Good Hope, are reducing the tides according to harmonic methods. Similar work is being carried on at several points, and the result will be of much interest for the purpose of valuing the degree of elastic yield of the earth's figure. Prof. Lawrence said that a large number of wrecks in past years was due to our want of knowledge of tides and tidal currents in the Gulf of St. Lawrence.

"Professor Schuster read a report of a committee appointed for the purpose of considering the best methods of recording the direct intensity of solar radiation.

"Professor Douglas Archibald spoke of the sun-glows and halo in connection with the eruption of Krakatoa. He believed these sun-glows were due to the widely diffused dust from the eruption of Krakatoa. He also spoke of the remarkable halo to be seen near the Sun. On looking up into the sky and shading the eyes, a cloud would be seen before the Sun, edged with a halo of a pink or salmon color. This halo does not seem to be reduced in the slightest degree and evidently has no connection with the vivid sunsets. The dates of the commencements of the sunsets form a ring of dates, beginning at the Isle of Java, and the further the distance from Java the later the dates of rings.

"Mr. Henshaw read a paper on frasil ice, or anchor ice. The paper traveled over the common theories without adding much to our knowledge. Probably

the ice forms at the surface, and is carried down where re-gelation takes place. Prof. Claypole said frasil ice was found even in the head-waters of the Thames. The stones in the bottom of streams seem to radiate their heat in clear water so rapidly that anchor ice was formed.

"The Earl of Ross read papers on 'An Electrical Control for Equatorial Driving Blocks,' and on 'Polishing the Secula.' This is a son of Sir John Ross who constructed the forty-foot reflecting telescope.

"Professor Douglas Archibald read a paper on 'Some Preliminary Experiments with Anemometers attached to Kite-wires.' He wanted to send up his anemometer on a kite, but could not make his kite stand still in the air so as to get a correct measurement of the wind, until he devised some inverted funnels attached to the kite's tail which the wind caught, and so pulled the kite both ways at once. In this way he could send up his anemometer to almost any height, and make his kite stand perfectly still for hours. These English savants are very ingenious to devise methods to carry on their investigations.

"In the section of chemistry Sir Henry Roscoe read an interesting paper on the diamond deposits of South Africa and the ash of the diamond. Mr. Harold B. Dixon read a report on chemical nomenclature, advocating the adoption of a nomenclature which should become universal and permanent. Many other valuable papers were also read in this section.

"In the geological section President W. T. Blanford, F. R. S., occupied the chair and Prof. T. G. Bonney, F. R. S., read a paper 'On the Archæan Rocks of Great Britain.' The paper indicated a general correspondence between these rocks and the Archæan rocks of Canada.

"Dr. T. Sterry Hunt followed with a paper on 'The Eozoic Rocks of North America.' He found among the pre-Cambrian strata of North America an invariable succession of crystalline stratified rocks, which have been by him divided into several groups, the constituents of which become progressively less massive and less crystalline, until we reach the sediments of palæozoic time, of which the Cambrian rocks, with the exception, perhaps, of the lowest or fundamental gneiss, present evidences, direct or indirect, of the existence of organic life at the time of their deposition. He included these rocks under the general title of Eozoic, a term first proposed by Sir William Dawson. This paper was discussed by Major Powell, James Hall, Sir William Dawson and others.

"Professor James D. Dana contributed a paper, 'On the Southward Ending of the Great Synclinal in the Taconic Range.'

"Mr. V. Ball, F. R. S., read a paper, 'On the Mode of Occurrence of Precious Stones and Metals in India.' The paper treated of the diamond, ruby, sapphire, spirel, beryl, emerald, lapis lazuli, gold and silver, and gave information not contained in the books.

"The section of biology has attracted much attention, and valuable papers were read by Mosely, Struthers, Dobson, Marshall, Saunders, Hughes and others.

When Lieutenant Greely and wife arrived, they were met at the station by

Capt. Pim, who accorded them a hearty welcome. They drove to a hotel, and shortly afterwards were waited upon by a deputation from the British Association, and conducted to McGill University. Lieut. Greely seemed suffering greatly from the fatigue of the journey to this city.

When Greely entered the hall he was immediately surrounded and welcomed in an impressive manner by Sir Henry Lefroy. Sir Henry said he as well as all geographers and scientific men of Great Britain and the whole of Europe had followed with great interest the efforts made to relieve his party, and hailed with the keenest delight their rescue. Lieutenant Greely, in reply, remarked that he was delighted at being invited by the British Association and at attending, and only wished he could do more than he would be able to do. He would, of course, connect himself with the geograpical section principally, and would contribute some of the results of the expedition. In reply to Sir Henry's inquiries, Lieutenant Greely stated that the meteorological observations had not been reduced. In an animated manner he proceeded to speak of some of the work done by the expedition. One of the most interesting results will be a comparison of the swinging of the pendulum, at the furthest point north reached, with that at Washington. He explained that although most of their instruments had to be abandoned, the pendulum apparatus, which weighed ninety pounds, was brought back and has been sent to Washington. He remarked with evident pride that he had told his party that the pendulum was a very important instrument, but that if one man of the twenty-five complained he would abandon it. None would hear to this, and a very important comparison is thus made possible. Speaking of observations of temperature, he stated that the lowest temperature ever recorded was that experienced in February last, when the mean temperature was 50° below zero.

"On Friday Lieut. Greely read a paper on Arctic exploration in the section of Geography. His presence attracted a vast throng. Lieut. Ray was present and partook in the discussion. Lieut. Greely said the tides from the North Pole were warmer than those from the South, and he favored the existence of a north polar sea.

"In the section of Anthropology, Mr. F. H. Cushing read a paper on the development of industrial art among the Zunis of New Mexico. Mr. Cushing joined the tribe of the Zunis in order to find out their secrets.

"He was keenly observant, and he shows a series of remarkable diagrams, explaining the result of these observations. The Zunis live chiefly in the desert, and anything they grow they produce by irrigation. Their pueblos or towns are built of mud and fragments of stone. Mr. Cushing has prepared a great number of elaborate pictures, showing their works of pottery, which includes a great number of curious designs. All their present examples had their origin in the rude necessities of a rude life. Gradually, as though by process of evolution, they assumed conventional shapes, and, in the course of time, conventional decoration was added. The rude vessels, at one time subservient only to daily wants, had a symbolic character given to them, and many of them now served

the sacred purposes of religion. Mr. Cushing believes that the study of archæology should be backwards and not forwards. By seeing these people in a savage state, becoming acquainted with their primitive modes of life, their rude arts, their struggles to survive and to equip themselves with what implements and devices their limited ingenuity could plan, accurate analogies might be made of the primitive condition of other races. For example, in South America where large animals abounded, the savage tribes used their paunches, after they had killed them, as their first holding vessel. After the lapse of time, when their powers of ingenuity had expanded, and they were able to make a vessel of clay, it took the shape of the animal's paunch. And, to complete the resemblance, it had colored streaks up the sides to resemble veins. So with the Zunis. They first made a rude basket out of grasses and strips of bark. Then they put moist clay upon the interstices to stop the leakage and used it for cooking purposes. The discovery that clay was fire-proof was speedily taken advantage of in the structure and baking of a number of vessels, whose shape was determined by some local circumstance or necessity. These vessels, then, gradually assumed symbolic shapes, as we have mentioned. To understand their significance it was necessary that he should first master the Zuni language, and this Mr. Cushing has done so well that he speaks it like a native. Each vessel had its own peculiar name, and once he got the etymology of it, the ritualistic significance of the vessel was soon apparent. There was a peculiar bowl which was of the highest religious value. It had a representation of the clouds where the gods were supposed to dwell; of the sea, as representing the water which the gods, when in propitious mood, sent down to them in the form of rain, and for which they were very grateful, as the climate was hot and dry; of water beetles, which were types of spring, as they were found in the water only in this season, and of certain forms of flies as types of summer. Winter was omitted. They held that winter was sent by the gods as a punishment, and they did not consider it as one of the regular seasons. Mr. Cushing has reproduced every form of vessel and every instance of architecture from the earliest history of this interesting period, and his descriptions and expositions are fraught with the deepest interest.

"Last evening Dr. Dallinger gave the most brilliant lecture of the meeting on 'Researches of the Modern Microscope.' Queen's Hall was filled with an audience made up of the most distinguished men of two continents. The lecture was illustrated with the calcium light, and it has never been my good fortune to have seen anything to compare with it. Lord Rayleigh declared, at the close of the lecture, that he had never seen it surpassed. The lecture embraced the results of over ten years of observation, of two observers. The observations were made continuous, one observer working while the other slept, so the whole history of the bacteria was gathered up. One can judge of the minuteness of these animals when we consider that 50,000,000 of them will occupy one-hundredth part of a cubic inch. At some points of his investigations, Dr. Dallinger was compelled to wait until more powerful lenses than had been known to the world could be constructed. Perfect images of these infinitesimal animals were thrown

upon a white screen fifteen feet square, and the beauty of these monads, which sometimes resembled the most exquisite plants, cannot be described. Prof. Dallinger said they were evidently created to work over dead matter, and prepare it for use by living organisms. Sometimes one of these strange forms would begin to constrict around the center, while both ends would become an animal, and then each would begin to pull in opposite directions, and 'with a long pull and a strong pull and a pull all together' they would break the ligament binding them together, and both spin off in their new orbits. Dr. Dallinger's investigations have utterly disproved spontaneous generation.

After a most busy week, in which results were put on record of the recent work of a great number of savants in numerous departments of investigation, the Association closed up the business of its first meeting in America, at Montreal, September 3. The number of papers read and the discussions were always interesting, but there have been no such wonderful discoveries announced or original theories advanced as stand out so prominently in the *Transactions* of the British Association of many former years. It would not be just, however, to assume that on this account the work done indicates any less keenness in scientific research.

Among the papers read in the mathematical and physical science section that excited considerable attention, was one by Prof. O. J. Lodge, as to the seat of electromotive force in the voltaic cell. Sir William Thomson said he regarded the paper as a landmark on the subject. Then Sir William threw some light on the matter from his own observation and experience, and he was followed by Profs. Fitzgerald, Silvanus Thompson, Dr. Fleming, Prof. Gibbs, and Drs. Schuster and Macallister.

In the chemical section, Prof. Frankland, the well known author, took up the subject of the batteries for the storage of electrical energy. While admitting the great loss of power in these batteries when not in use, he was disposed to think from his experiments that they have a brighter future than many electricians are willing to admit. After him came Prof. George F. Barker, who called attention to the shortcomings of the batteries, which, according to his calculation, do not return over 6 per cent of the energy put into them.

A paper before the geological section, by W. F. Stanley, F. G. S., had the following points: "The theory of Dr. Croll, accepted by many geologists, is that the former glacial periods in the northern hemisphere were due to greater eccentricity of the earth's orbit and to this hemisphere being at the time of glaciation in winter perihelion. This theory is supported upon conditions that are stated to rule approximatively at the present time in the southern hemisphere, which is assumed to be the colder. Recent researches by Ferrel and Dr. Han, with the aid of temperature observations, taken by the recent Transit-of-Venus expeditions, have shown that the mean temperature of the southern hemisphere is equal to, if not higher, than the northern, the proportions being 15.4 southern, 15.3 northern. The conditions that rule in the south at the present time are a limited frozen area about the south pole not exceeding the sixtieth parallel of latitude,

whereas in the north frozen ground in certain districts, as in Siberia and Northwestern Canada, extends beyond the fiftieth parallel; therefore by comparison the north, as regards the latitude in which Great Britain is situated, is at presen the most glacial hemisphere. As it is very difficult to conceive that the earth had at any former period a lower initial temperature, or that the sun possessed less heating power, glaciation in the north could never have depended upon the conditions argued in Dr. Croll's theory. The author suggested that glaciation within latitudes 40° and 60° was probably at all periods a local phenomenon, depending upon the direction taken by ærial and oceanic currents, as, for instance, Greenland is at present being glaciated. Norway has a mild climate in the same latitude, the one being situated in the predominating Northern Atlantic currents, the other in the southern. Certain physical changes suggested in the distribution of land would reverse these conditions and render Greenland the warmer climate, Norway the colder."

In regard to sunspots and terrestrial disturbances, Prof. Arthur Schuster, of Owens College, Manchester, said their periodicity was not regular. Sometimes they appear every eight years, and sometimes not for sixteen years. The period is about every eleven years. There is ground for believing that there are two periods of ten and a half and twelve years superposed on one another. Magnetic variations, that is, variations of the magnetic needle, occur at such times, which are quite marked. The magnetic needle points to the north and the south. It does this, however, approximately, and follows the course of the sun somewhat. In the morning it begins traveling westward, and in the afternoon it starts on its run to where it began. This daily excursion of the needle is much greater when there are many spots on the sun. The proportion in England is as three to two, and in Germany as seven to four. At times, too, the needle travels irregularly to and fro. These needle vibrations are magnetic storms. The speaker referred to the noted storms of 1859 and 1872, at the time of great outbursts on the sun, and said that if the sun were of solid steel, magnetized to the highest extent of which it is capable, it would not affect terrestrial phenomena to such an extent, It was rash to say that the space between the earth and the sun did not contain sufficient matter to conduct electricity from one to the other, but leaving electric influence out of the matter, because we know nothing of the subject, we come to the question, "Does the sun radiate more or less at the time of the prevalence of sun spots?" This was not definitely ascertained. The trouble has been in trying to ascertain the sun's radiant heat, and we have not been able to get rid of disturbing factors, one of which is the variance in the absorption, reflection, etc., in the atmosphere at different times of the day. Prof. Schuster suggested the establishment of an observatory station on Himalaya Mountains, about 20,000 feet above the level of the sea. He then pointed out the difficulties in the way of determining the solar heat, and called attention to the thermic curves. During the period between 1810 and 1860 there was a remarkable correspondence between the mean temperature curves and the prevalence of sun spots in unusual numbers. The good wine years on the Rhine correspond with the years of mini-

mum sun spots. Hot summers follow after a period of maximum sun spots. Destructive cyclones on the Indian Ocean and around the West Indies, it has been observed, are greater in the years of maximum sun spots. At the time of many sun spots there was seen a comparatively large number of comets around the sun. The speaker thought it not improbable that the periodicity of sun spots was produced in some way by meteoric streams whose orbits approached the sun at the times of the frequent sun spots. The address was discussed learnedly, and further light was thrown on the subject by Profs. Balfour Stewart and W. Lant Carpenter, who took up the matter of short periods common to solar and terrestrial phenomena, and a report was submitted on meteoric dust. Other matters discussed were the measurement of solar radiation and recent progress in photographing the solar spectrum. The Earl of Rosse epxlained an electrical control for equatorial driving clocks.

An interesting address before the chemical section was by D. W. H. Perkin, Ph. D., F. R. S., of Sudbury. He turned the room into a laboratory, and gave a most exhaustive address on coal tar coloring matters, which was illustrated by numerous experiments. The beautiful colors obtained from the various products of coal tar distillation were exhibited, the methods of manufacture and application explained, and reference was made to the discoveries of new ways of producing cheaply and abundantly the substances used in making the most brilliant dyes. The speaker colored strips of yarn, washed them, fixed the colors, and then exhibited them all in full view of the audience.

"There is a hurrying to and fro, and the great scientists are getting ready to depart in various directions. One might as well try to eat a buffalo for breakfast, or drink the water that tumbles down Montmorency Falls, as to report the British Association of Science. I have only tried to give a few glimpses of the workings of this vast organization which formulates the best scientific thought of the British Empire."

ASTRONOMY.

SUN AND PLANETS FOR OCTOBER, 1884.

W. DAWSON, SPICELAND, IND.

The earth in its revolution round the Sun moves nearly one degree a day, and this gives the Sun an apparent motion eastward to the same extent, equal to about four minutes of time. So the Sun's R. A. (distance east of Vernal Equinox on celestial equator) increases nearly four minutes every day, and about two hours a month. On the 1st of October it is 12h. 33m., and on the 31st 14h.

25m. This eastward motion of the Sun makes the stars appear to go as far westward and set four minutes earlier every day.

The Earth's orbit being inclined to the celestial equator, and now moving in its northern half, gives the Sun a southern declination; which, October 1st, is 3° 32′, increasing to 14° 25′ on the 31st. This increasing southern declination of the Sun causes a shortening of our days from 11h. 40m. to 10h. 20m. Spots on the Sun are still numerous, though quite variable in number and size. Only fifteen were visible September 2d, but ninety were counted on the 11th; one large group near the center of the Sun having seventy-seven spots.

Full Moon occurs on the 4th of October, when there will be a lunar eclipse —total in Europe and Africa; but the Moon don't rise here until the total phase is passed; so there will only be a partial eclipse in Eastern America—but *it* will hardly extend as far west as Kansas City—being over before the Moon rises there. On the 18th new Moon occurs, when there will be a partial eclipse of the Sun, visible to northwest America, north Pacific Ocean, and Eastern Siberia. It will extend over California, Oregon, and Washington Territory, just before the Sun sets there.

The morning skies in October this year will display a diamond brightness. Some of the most brilliant stars are now at their heights in early dawn—notably Sirius, Aldebaran, and Cappella, the grand constellation of Orion, and the beautiful Pleiades. All the bright planets, except one, are also morning stars. On the 1st Mercury rises at 4:30 A. M., just a little north of due east. Thus it may be easily seen for a few mornings in the fore part of October. Venus rises soon after 2 A. M. and is much the brightest star now visible. Through September it could easily be seen with the naked eye at 9 A. M. when near the meridan. It will not be quite so bright in October. It still crosses the meridan about 9 in the morning, at an elevation of 62° in the fore part of the month and 52° on the 31st. Venus will be near Jupiter in the morning of the 6th. It also passes near Regulus, a star of first magnitude, in the evening of the 7th, and will be near enough to be worth looking at in the mornings of the 7th and 8th.

Mars is now a day object—rising about 9 A. M. in the southeast and setting near 7 P. M. in the southwest. Hence of little or no interest. Jupiter is just north of Venus in the morning of the 6th. They are both fine objects for observation with a telescope. But Saturn is still prettier, and four hours west—near the boundary between Taurus and Gemini; on the meridian a little before 5 A. M. October 1st, and two hours earlier on the 31st. The ring is near its widest, and is a lovely object for observation. In the latter part of October Saturn will rise about 8 P. M. Uranus is near the Autumnal Equinox, in 12 hours of R. A. Neptune is in Taurus, about 7° southwest of Pleiades.

SOLAR DYNAMICS—SOME NEW ASTRONOMY.

REV. JAMES W. HANNA.

We hear of the "new astronomy" on every breeze. Can we have a finger in the matter? The advice of Mrs. Jack Means is, "While you're gitten, git a plenty." The builders of the new had better gather it all in. So here is our offering.

In an article on the forces of inorganic nature, published in the September number of this REVIEW, speaking of repulsion as a force co-ordinate with attraction, I said, "This drives volatile matter from the comets, thus making their tails. This causes the diurnal revolution of the planets. This gives to the several planets their distances from the Sun." To some this may have appeared a reckless assertion. It was made, however, in the light of convincing proof. That proof could not be presented then. It, and much else, had to be reserved for another time. Having accepted the doctrines advanced in my former article; regarding all the physical attractions in the realm of inorganic nature as of one origin, and all the repulsions as of one origin, believing heat to be something else than motion, that repulsion is from its self-repellence, and attraction from its affinity for matter, and that heat is a factor in gravitation; with these principles, wanting further confirmation, I went into the realm of astronomy to see what answer we might get from this quarter touching these matters. Here I got more than was expected; much that was not expected. Some clearing of the decks was indulged in. Original impulse as effecting any sort of planetary motion was discarded. Because there is no perfect vacuum, and, therefore, always some resistance, and because of counter attracting forces that would in time bring to an end the momentum caused by an original impulse, we conceded that all planetary motion results from forces in constant operation. The question then was how account for what is called the centrifugal force? Next, what causes axial revolutions?

On my theory of attraction and repulsion, there may be from the same attracting source little attraction, more attraction and most attraction, owing to the nature of the body affected. And so there may be from the same repelling source, little repulsion, more repulsion, and most repulsion, owing to the nature of the body repelled. By this theory, in the solar system, those planets in whose composition is the greatest proportion of heat will be farthest from the Sun; and those planets in whose composition is the least proportion of heat will be nearest the Sun. So we have it. The hotter planets are more remote; those relatively more material are nearer. To this Venus is no exception, though its case is peculiar. Then, however it may be accounted for, we find the distances of the planets determined as by a law growing out of these principles, and as though one law reigned throughout the realm of nature.

As to axial revolutions, if these result from forces in constant operation, but

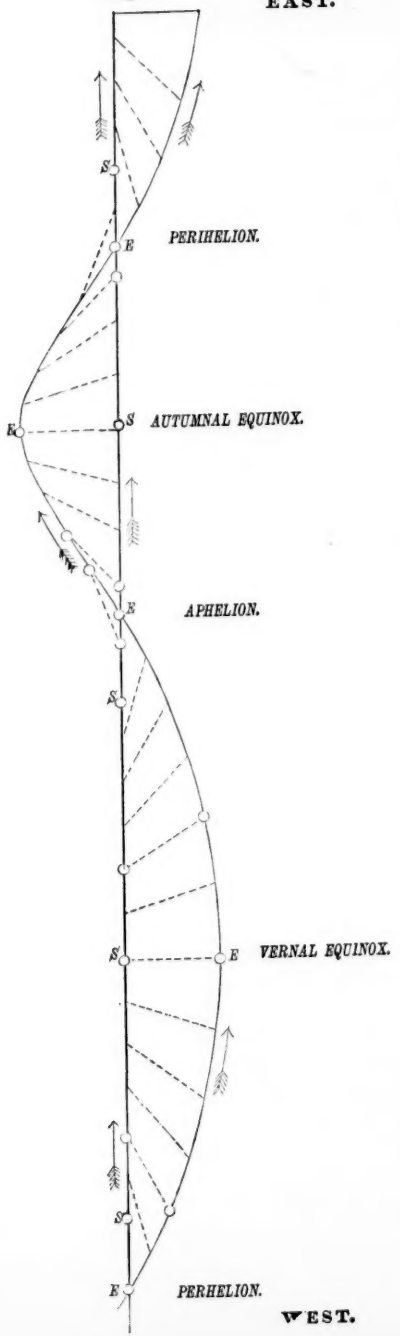
two processes are conceivable. One by two pulls from different directions, having different centers of force, on different sides of the center of the revolving orb. The other by a pull and a push from the same direction, having such different centers of force. For a while I favored the first of these. Now it is rejected, for two reasons. First, it seems manifest that all attracting forces affecting an orb would have a common center. Second, as the satellites are subject to these pulls from different directions, they too should revolve if this caused axial revolutions. On the other hand if axial revolutions are caused by repulsion, first, only hot bodies will cause these revolutions. So we have it. The planets under the rule of the sun all revolve; the satellites under the rule of the cool planets do not, but, held as by a strong grip, they move around, as that grip causes them to move. Second, if the axial revolutions are caused by repulsion, the rapidity of the revolution will be affected, first by the force of the repulsion, and second, by the length of the diameter of the revolving orb; as this will afford more leverage to the diverse forces. The student of astronomy will see that the axial revolutions seem to harmonize with a law growing out of these principles. It may be asked why grant that attraction and repulsion, the pull and the push, have different centers of force in the revolving planet? If where there is most heat there is most repulsion, and where least heat most attraction, the repulsion will always be strongest on the afternoon side of the planet. With more push on the one side what can we have but axial revolution. And the rapidity of the revolution must be determined in great measure by the factors above named.

While studying the movement of the planets diagrams were freely used, diagrams of movement at various rates and in many different directions. And here much may be learned. You may conceive of the Sun as moving on any line passing through its own center; assume that it is moving at a certain rate, and you may diagram the movement then required of the solar system. The movement on any line requires a diagram of its own different from any other. For example, if the earth moves in the plane of the ecliptic, there is but one line on which the Sun can be moving, viz: that of the intersection of the ecliptic with the plane of the solstitial colure. Again, if the ecliptic is made up of a succession of parallel planes, there is but one line on which the Sun can be moving, viz: the line on the solstitial colure perpendicular to the plane of the ecliptic. So also any given velocity requires a diagram of its own. Any change of direction, or any change of velocity requires a change of the diagram representing the movement of the system. The diagrams here given on Plate I represent the movement of the earth if the Sun moves in the plane of the celestial equator on the line of its intersection with the solstitial colure, and at a velocity of twenty-seven miles per second. Fig. 1 is a horizontal view as seen from the north. Fig. 2 is a perpendicular view as seen looking down from above. In Fig. 1, at perihelion the earth is north, and at aphelion south of the line, as seen in Fig. 2. In Fig. 2, at the vernal equinox the earth is above the line, and at the autumnal equinox below it, as seen in Fig. 1. The figures on Plate II include the Moon's movement, and give us a hint on the cause of apogeal advances and regressions.

PLATE I.

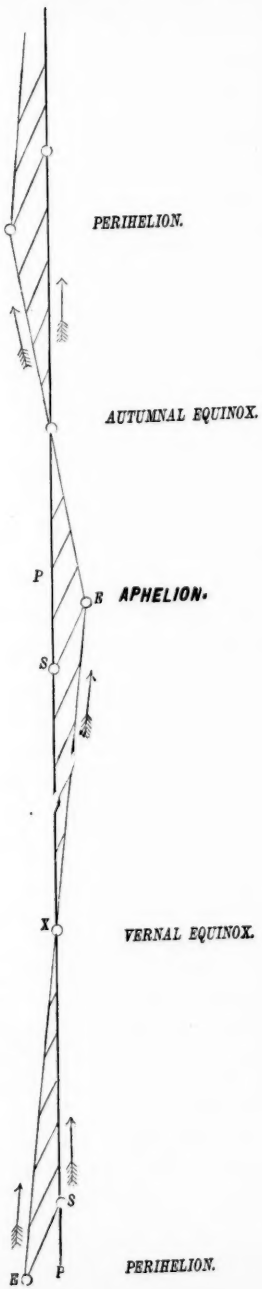
Fig. 1

EAST.



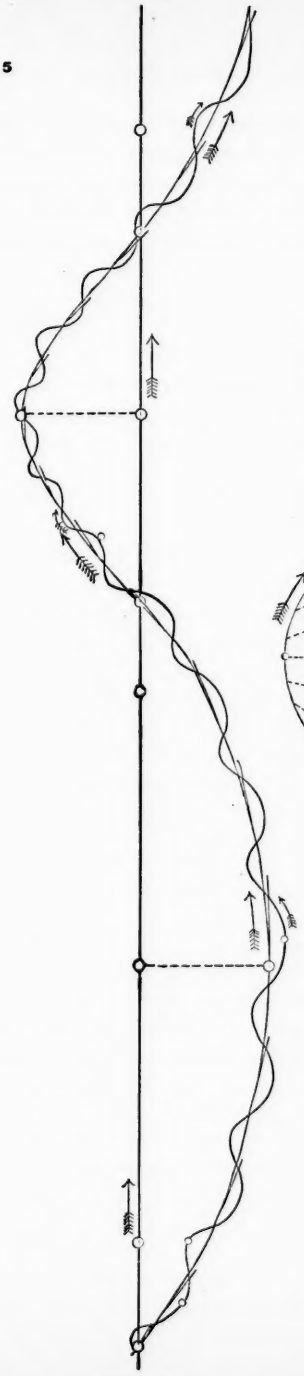
WEST.

Fig. 2



EAST.

Fig. 5



WEST.

Fig. 3

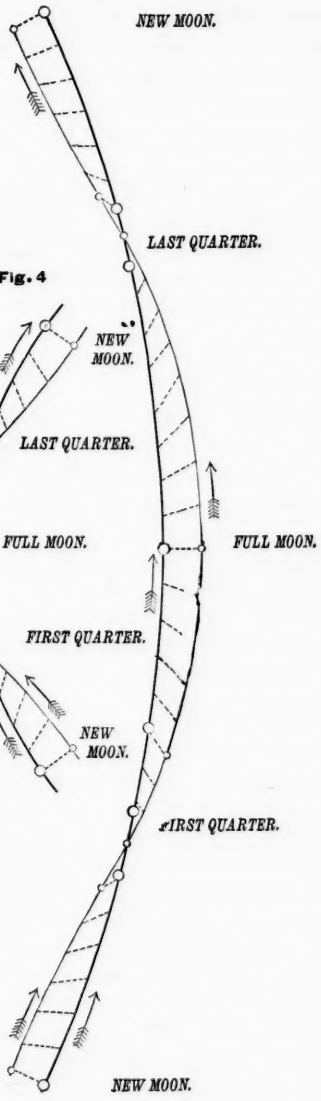
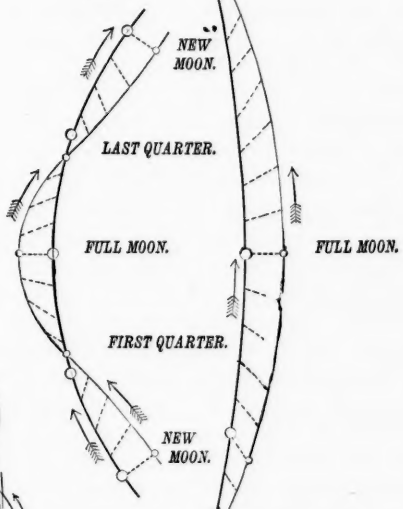


Fig. 4



And now let us consider some things preparatory to making diagrams. We have the celestial heavens, with the North and South Poles, the celestial equator, and the ecliptic. These give us our points of the compass, and enable us to locate planes. In the diagrams the following things are to be observed:

1. Parallelism of axis. The planets must keep their equatorial planes in position.

2. A direct line from the Sun to the center of the earth must never strike the earth more than 23½° north or south of the Equator, but must reach that latitude, once north, and once south, during each revolution.

3. In each case we have a hypothesis as to the rate of the Sun's motion; hence we know how far it would move during the revolution of each planet. This distance, and the distance of each planet are to be carefully observed in the scale adopted in the diagram.

4. During the revolution of each planet, the Sun must pass over nearly equal distances in equal times.

5. The relative position of each planet and the Sun during a revolution must be such as to form an ellipse.

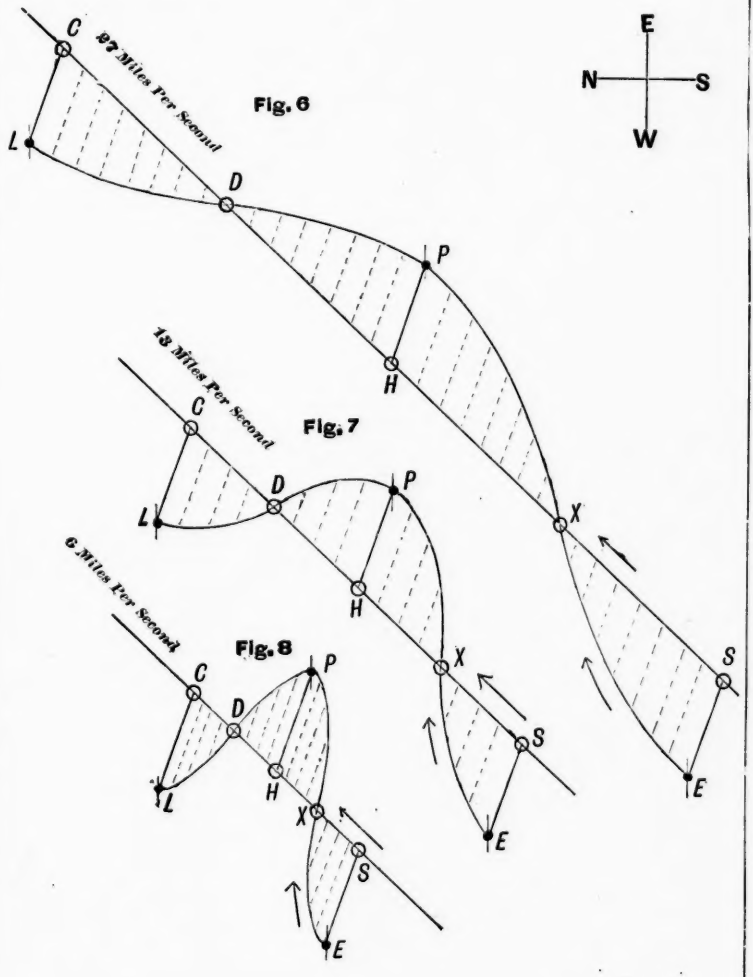
Observing the above conditions we present a few diagrams. Each shows what the path of the earth would be, did the Sun move in a given direction and at a given rate. These diagrams have reference not only to a particular latitude, but to a particular point in the heavens: for not only the latitude, but the longitude of the movement, affects the diagrams. These few diagrams, among the many that might be given, serve to illustrate general principles.

In the expanse of the universe, you may, if you please, regard the solar system as small as a train of cars. If it were as small as a compass, or as the instruments which the astronomer uses, its pointings would still be exact. We want to use the system itself, as though it were an instrument, for certain mathematical demonstrations. Our figures are made on a plane either of longitude, or of latitude, in which the Sun is assumed to be moving.

Plates III, IV, and V are on the plane of the solstitial colure. In the diagrams on Plate III the movement is toward 47° north declination. In Fig. 6, the rate of the Sun's motion is twenty-seven miles per second. At this rate, the Sun moves in one year nine times the distance from the Earth to the Sun. We draw our lines accordingly. The line S C represents the Sun's line of passage in one year. And S E represents the earth's distance from the Sun, which, during the year, is to vary so as to form an ellipse. Next we divide S C into four equal parts. The Sun passes over one of these during a quarter of a revolution. We propose to start at the winter solstice. And we know just where to locate the Earth. There is but one place possible. At the winter solstice the earth is in this plane, the plane of the solstitial colure. And then, a direct line from the Sun to the earth's center makes an angle of 23½° to the plane of the earth's equator. Then the earth can only be at E. In six months the Sun will be at H. And the Earth is again in this plane, the plane of the solstitial colure. And now

PLATE III.

Direction 47° North
Vertical View



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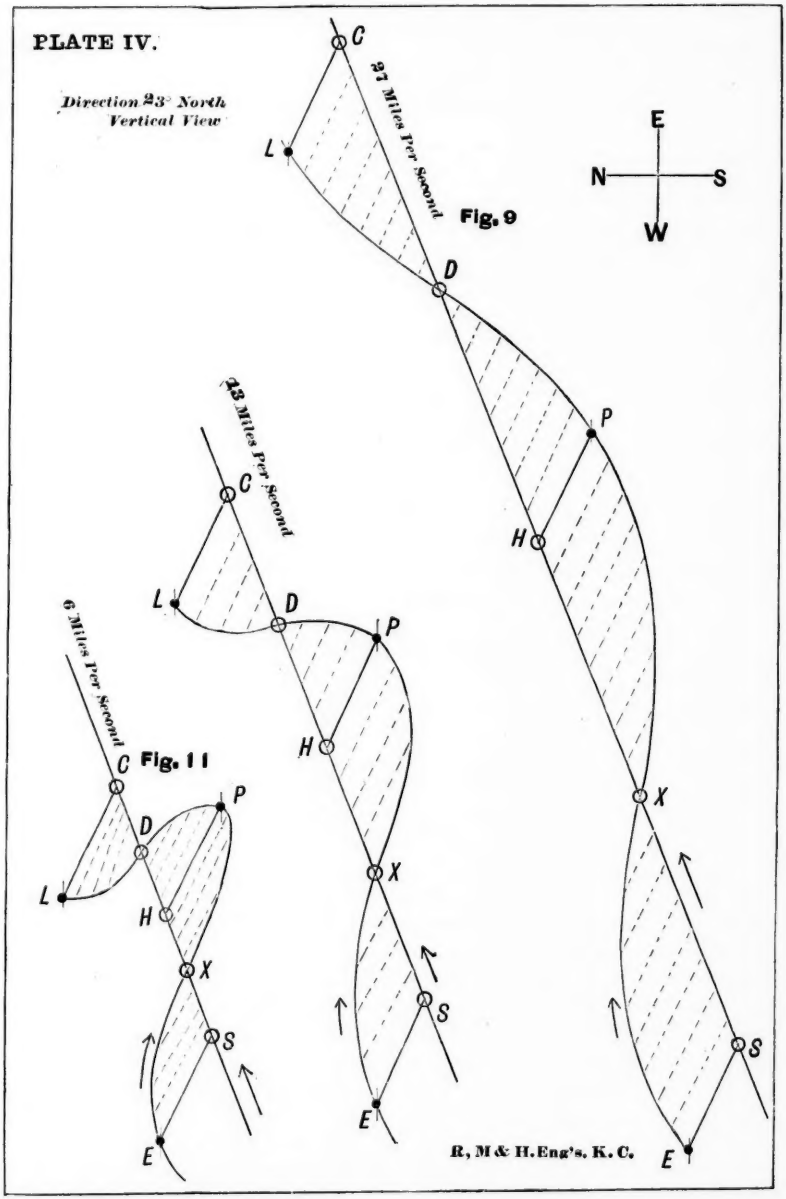
PLATE IV.
Direction 23° North
Vertical View
27 Miles Per Second
Fig. 9
23 Miles Per Second
6 Miles Per Second
Fig. 11
C
L
D
P
H
X
S
E
N
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E
W
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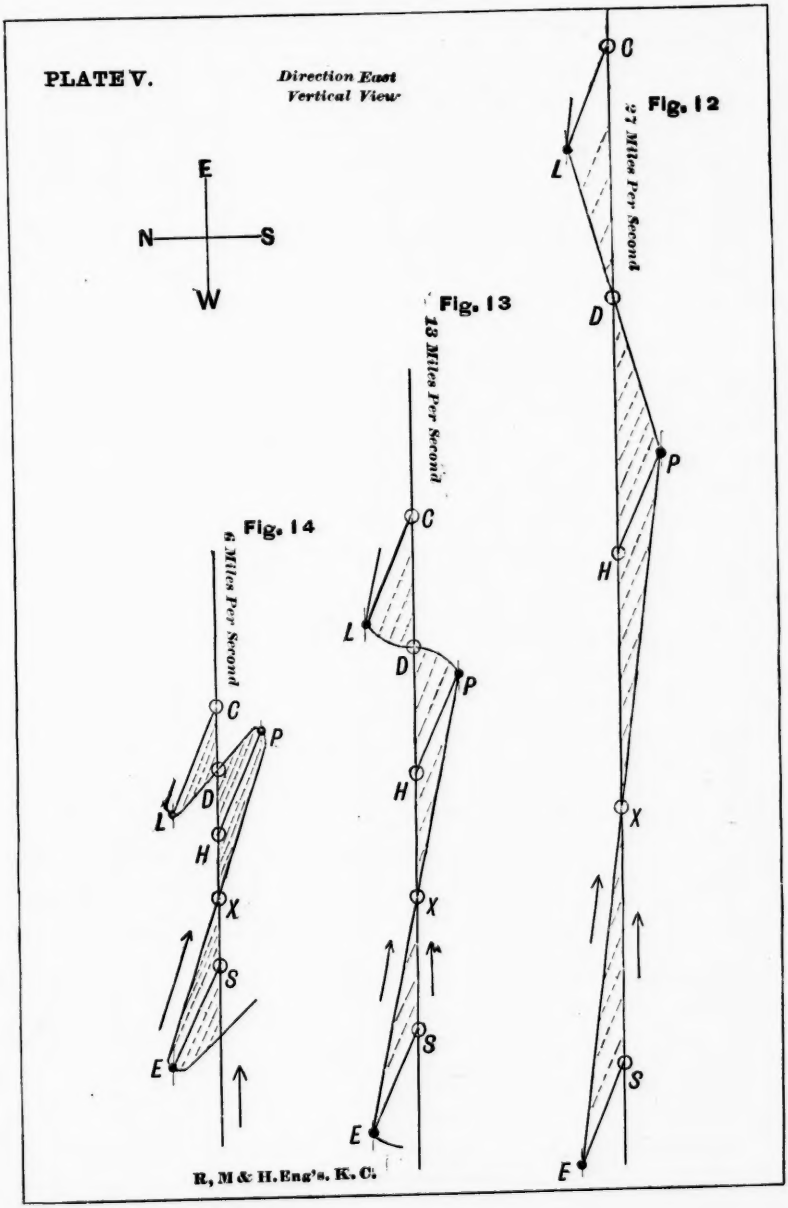


PLATE V.
Direction East
Vertical View
E
N
S
W
Fig. 12
27 Miles Per Second
C
L
D
P
H
X
S
E
Fig. 13
13 Miles Per Second
C
L
D
P
H
X
S
E
Fig. 14
6 Miles Per Second
C
P
L
D
H
X
S
E
R, M & H. Eng's. K. C.

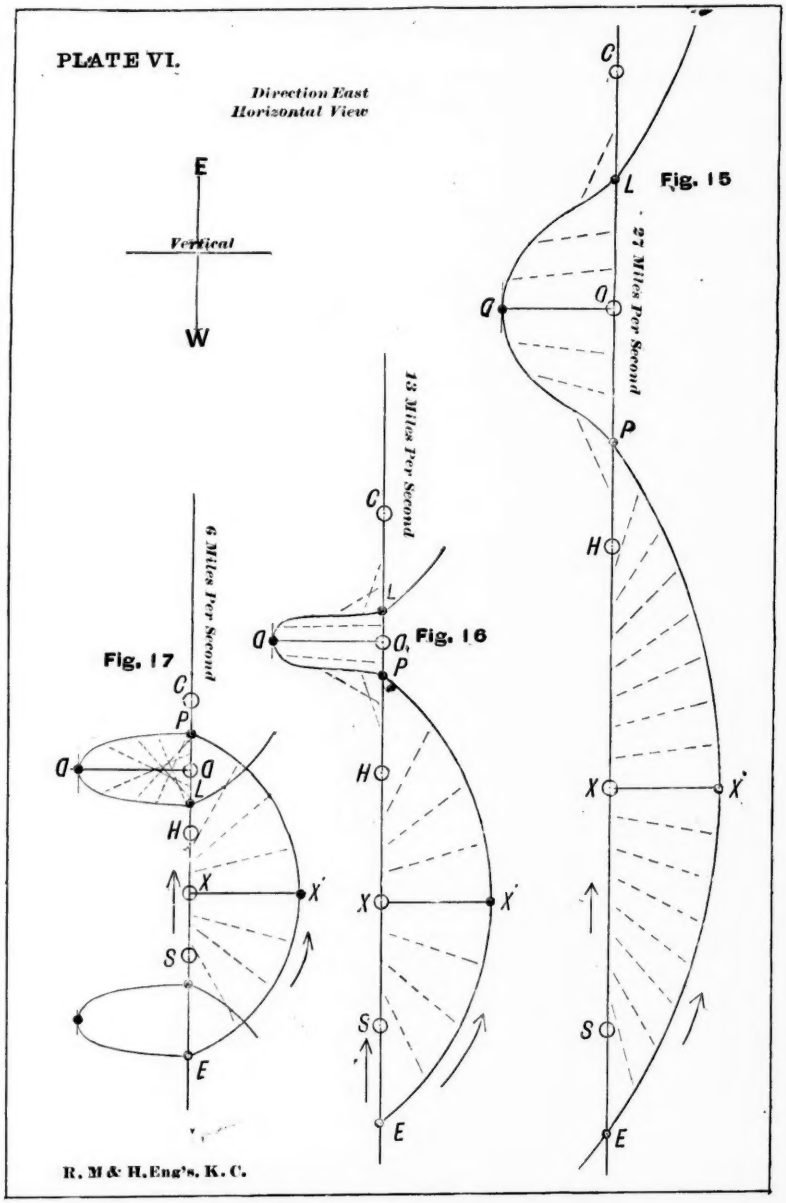


PLATE VI.
Direction East
Horizontal View
E
Vertical
W
Fig. 15
27 Miles Per Second
C
L
Q
Q
P
H
X
X'
S
E
Fig. 16
13 Miles Per Second
Fig. 17
6 Miles Per Second
R. M & H. Eng's. K. C.

a line from the Sun to the Earth will make an angle of 23½° on the north side of the equator. Then there is but one point possible for the Earth. It can only be at P.

The equinoxes too are fixed for us, for the plane of the equinoctial colure is perpendicular to that of the solstices. Then the equinoxes are at X and D. At X the Earth is 91,430,000 miles vertical to the Sun. And at D it will be 91,430,000 miles below the Sun. In one year the Sun will be at C. And then the earth will be at L, a position exactly corresponding with E. Year after year we will have this movement repeated. I trust the diagram is understood. The points E and P in the path of the Earth are in our plane. From E to P the Earth moves above, from P to L below, the line of the Sun's path. If the Sun moves in this direction, and at this rate, the earth's movement must be precisely as here shown.

The above description answers for each of the figures on Plates III, IV and V. In each of these we have the same plane, the plane of the solstitial colure; but different movements in the plane. In these figures we have three different rates of movement, and three different directions. The starting point of each is the winter solstice; when the earth is in this plane. And we know the precise point. It is at that point in the plane, where at its appropriate distance from the Sun, a line from the Sun will make an angle of 23½° with an east and west line, our equator. Now this is as definite as lines and angles in geometry can make it. As definite as the surveyor can be with reference to any locality. And the locality of the Earth at the times of the equinoxes is equally definite. At the time of the equinoxes the earth is, and must of necessity be, vertical with the Sun.

Referring again to our diagrams, on Plates III, IV, and V, at these several rates, and in these several directions, the Earth must be as represented at E. The same reasoning applies with regard to the points at P in these figures. The plane of the earth's equator is, and must of necessity be, at right angles to this plane. Hence it is evident, that at the summer solstice, the Earth is farthest south relative to the Sun. This farthest point south must be in this plane; and at such a point, that a line from the Sun to the earth's centre, will make an angle of 23½° on the north side of its equator. If we have the true distance from the Sun, the surveyor can tell the very acre in the universe of space in which this point will be found. And as we know where the Sun will be at the end of the solstitial year, we know that the Earth must be at L; the locations being determined precisely as the points E were determined. In all these figures the Earth in passing from E to P is above the line of the Sun's path, being at X 91,430,000 miles above it; from P to L it is below, being at D 91,430,000 miles below.

Are my positions thus far established? I have proved nothing as to the movement of the Sun. But I have proved that moving in these directions, and at these rates, the diagram shows where the Earth would be at the time of the solstices, and what would be its line of movement in making its revolution. If the astronomer knows anything incompatible with the showing in the diagrams,

then he knows something that proves that the Sun does not move as here assumed.

To diagram the whole solar system moving in any of these directions, and at any of these rates, we have but to give the several planets their respective distances, giving to each such position on this plane, as its time, its distance, and the inclination of its orbit demands. Then find how far the Sun will move at the assumed rate during the revolution of the planet, divide this into four sections, and proceed as in the case of the Earth.

Before passing, a word in explanation of the figures on Plate VI. They are horizontal views of the movement as represented on Plate V. In the figures on Plate VI, E must be regarded as above the plane, and P below it. Imagine you take the figures on Plate V and roll them over toward the south till P is down, and E up, or till X and D are in this plane at X^1 and D^1, and then you have the figures on Plate VI. These figures are interesting in that they show how different may be the movement in making a revolution. Each planet has a figure of its own, some more like one of these, others more like another.

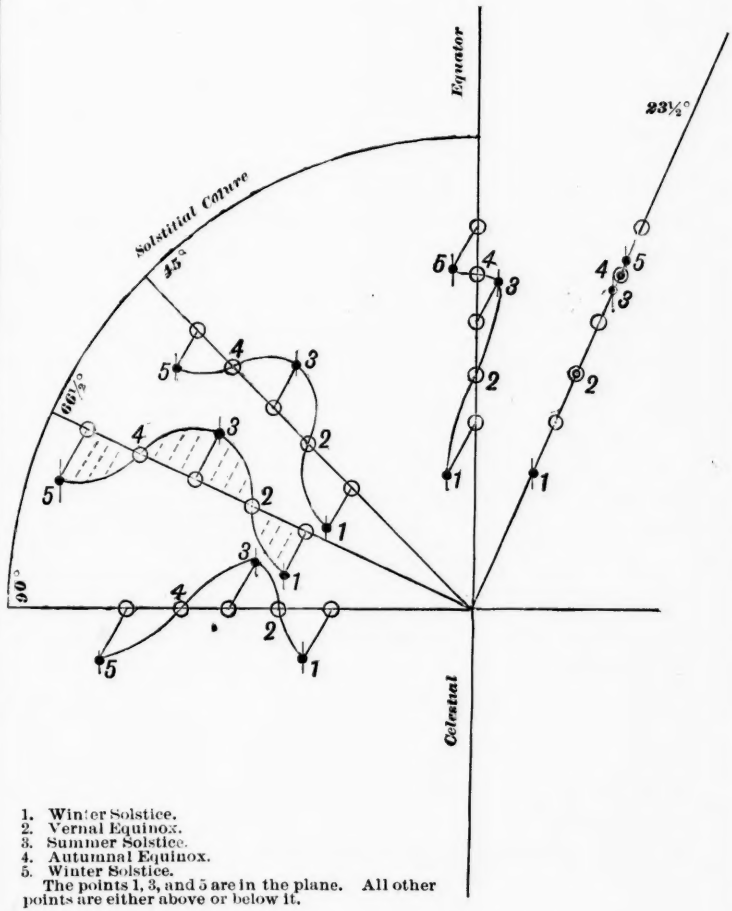
Plates VII and VIII are introduced for the purpose of illustrating principles.

Plate VII is on the plane of the solstitial colure. Plate VIII is on the plane of the equinoctial colure. Comparing the figures on one plate with those on the other, we see the effect of a motion toward different longitude. Comparing the figures on the same plate with each other we see the effect of a change of latitude. The effect as regards the form of coil. The effect as regards the planets velocity. Its velocity as related to the movement of the Sun. Its velocity *at one time*, as compared with *another*. Its real velocity as compared with its apparent velocity. We see under these different conditions, the different methods of producing apparent velocity, and apparent movement. This thing followed up will show that every new hypothesis as to direction, will require a new form of diagram, involving changes affecting all these relations. For example, in the diagram on Plate VII in the direction of 66½° north, the successive revolutions of the earth give us a spiral coil. This is the only direction that will allow of such a coil. Or rather the only line in the heavens, for we may have the same movement on the line, in either direction. It is the only line of movement which will allow the ecliptic to be made up of lines from a succession of parallel planes. It is the only line in the heavens where the earth can possibly, in harmony with known phenomena, keep pace with the Sun, as it advances through space. It is the only line in the heavens that allows of a regular correspondence between the real, and the apparent velocity of the earth, in the several parts of its orbit.

If we believe that constantly acting forces govern every planetary movement, and look after the cause of the onward movement of the planet in the light of our diagrams, we will soon have a decided partiality for some line of movement near the plane of the ecliptic. So here we can study *centrifugal force*, from a new base of observation.

Here we may get a well-defined conception of the ecliptic, as a *plane of rela-*

PLATE VII.



1. Winter Solstice.
2. Vernal Equinox.
3. Summer Solstice.
4. Autumnal Equinox.
5. Winter Solstice.

The points 1, 3, and 5 are in the plane. All other points are either above or below it.

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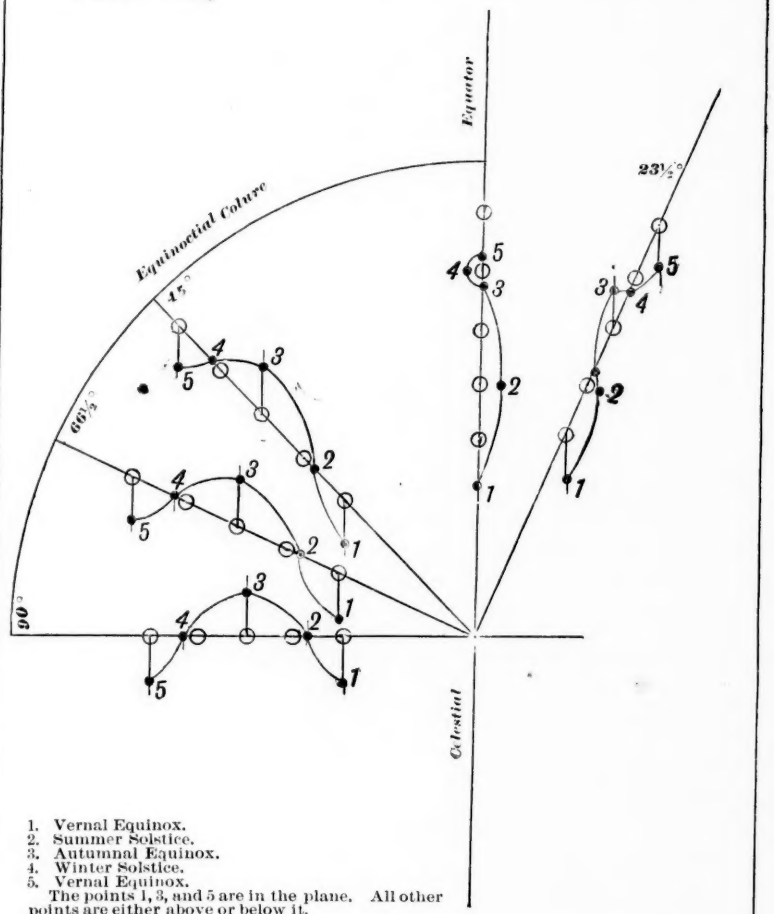
PLATE VIII,



1. Vernal Equinox.
2. Summer Solstice.
3. Autumnal Equinox.
4. Winter Solstice.
5. Vernal Equinox.

The points 1, 3, and 5 are in the plane. All other points are either above or below it.

R, M & H. Eng's. K. C.

tive position. The question as to just how it is formed, will be in a measure dependent on another question, as to the direction of the Sun's movement.

Just here allow a word, to anticipate an objection. It is admitted that computations are more exact than diagrams. But there are things with reference to which computations have nothing to say. All we ask for diagrams, is that they shall be heard where they have anything to say. And this the more, since what they teach is not in conflict, but in harmony with established truth.

We have seen that *in order to harmonize with the phenomena*, any change in the direction of the Sun's movement, must change the diagram,—must change, in other words, the shape of the path of the earth. Remember it is the phenomena that requires this, and not the laws of force. Under the new condition, the law of force would doubtless give us new phenomena rather than new shape to the path of the earth. The new condition would give to the ecliptic a new position. But the phenomena being and continuing as at present, every different line of movement, must give to the earth's path a different twist. And now we must ask the physicist: Will the laws of force and of motion allow of all these twists? Or do these laws, and the phenomena, require of the Sun movement in a definite direction? Here is a problem awaiting solution. What must be the direction, and the rate of the movement of the Sun, in order that, in accordance with known laws, we may have the known phenomena? If we cannot decide this definitely, can we approximate the definite?

The physicist and mathematician may not be able to settle it, but perhaps, there is enough in the vast range of facts, known, and knowable, to definitely fix the only possible direction of the forward movement of the solar system. You may as well talk of a disjointed machine working harmoniously, as talk of the solar system moving as it does, with anything out of place. Much less when the thing displaced is the movement of the master-wheel. The great complication of movement, the laws of force and of motion, will be somewhat rigid in requiring that the forward movement shall be none other than what it is. And the more so, as these laws are to be fulfilled, not only in the movement of the planets themselves, but also in the movement of their satellites. It would be a wonderful instance of accommodation in nature, if, the movement of the planets and of their satellites being just what they are, it made no difference whether the solar system were moving toward one latitude or toward another. We have certain known laws, and we have certain known phenomena; between these laws and these phenomena are certain unknown facts. It is these we are hunting after. The laws cause the facts; and the facts cause the phenomena. By necessity these facts have no wide range of possibility. They are in a strait betwixt two. They must conform to the laws; and they must be in harmony with the phenomena.

We have seen that with different direction of movement on the part of the ruling orb, in *order to conform to known phenomena*, there must be different procedure on the part of the subordinate sphere. This is necessary in order to maintain relation to a certain plane. What is true of the Sun in this regard relative to the planets, will be true of the planets relative to their satellites. That is

to say, any hypothesis that requires the earth to move, in the course of the year, in as many directions relative to the plane of its own equator, as are to be found in the quadrant of a circle, will require the Moon, in order to maintain its position relative to the equator, to make as many contortions as are seen in all these diagrams.

This is about what is required, if the Sun moves toward 47° north. Some one is ready to remind us of "the effect of two forces acting at the same time, in the same, or in opposite directions." Let that apply, where it applies; it has no business here. We have to do here, not with what forces, but with what in a given hypothesis the phenomena requires. If the law of force requires this, all right. But if it is only the phenomena that requires it in a hypothetical case, it is a different matter.

The above indicates why I reject the teaching of the books as to the direction of the Sun's movement.

We have it on high authority that the following is the mean inclination of the orbits of the planets to the plane of the Sun's equator.

INCLINATION OF ORBIT TO SUN'S EQUATOR.

Mercury	1°	18′
Venus	4°	58′
Earth	4°	37′
Mars	2°	42′
Jupiter	5°	28′
Saturn	4°	46′
Uranus	5°	9′
Neptune	4°	59′

If the orbits of the planets cut the Sun's equator at these angles, their paths will cut it at angles much smaller. If you would see this turn to Plate I. In Fig. 2, the line P S being parallel to the earth's equator, the angle E S P is the angle of the orbit with the equator; but the angle E X P would be the angle made by the crossing of the paths of the earth and Sun. If the Sun's path is more nearly in the plane of the ecliptic, as it surely is, the angle made by these crossing paths would be much smaller than as represented in the figure. I will here venture the prediction that it will yet be found that the paths of all the planets cross the path of the sun at an angle of less than two degrees.

Now observe, the orb that attracts the Sun and determines the direction of its movement, also attracts each of the planets, according to my theory even more powerfully, and in good part determines the direction of their movements. The planets would skip off and leave the Sun were it not for his power to hold them in check. "He rejoiceth as a strong man to run a race." If the Sun moved directly toward its ruling orb, all the equatorial planes of our system would coincide; there would be no lateral oscillation in the planets paths; and so, no seasons. Because of these diverse directions, at times, part of the force from both of its superiors tends to bring the planet into what may be called the

Sun's orbital plane; and then momentum carries it beyond. The movement out, on either side, is always from momentum; the movement in is effected by the forces as above explained. Thus the Sun in its revolution in 25,000 years, swings back and forth with reference to the orbit of its superior. Thus the several planets in the times of their respective revolutions swing back and forth with reference to the orbit of the Sun. Thus the moon in the time of its revolution swings back and forth with reference to the orbit of the earth. Thus the satellites of Jupiter and Saturn swing back and forth with reference to the orbits of their rulers. If in all these cases instead of saying orbit, I had said path, it would have been equally true, though orbits and paths are very different things.

The solar system presents many wonderful harmonies; so there is room here for analogical reasoning. As a rule satellites and planets make their revolutions nearly in the plane of their own equators. This would lead us to expect the same of the Sun. As a rule subordinate spheres revolve nearly in the planes of the equators of their primaries. This would lead us to expect that all, the Sun with the rest, revolve nearly in the same general direction. The plane of the moon's equator is south of the earth during one-half of its revolution, and north during the other half. The plane of the earth's equator is south of the Sun during one-half of its revolution, and north of the Sun during the other half. The plane of the Sun's equator is south of its ruler during one-half of its revolution, and north of its ruler (Sirius?) during the other half. The Moon makes its revolutions around the earth in a certain manner. Why should not the earth and and the Sun make their revolutions in like manner?

The forces affecting the Moon cause it to change its position relative to the earth amounting to four right angles in the direction of its own equatorial plane, while they cause a change at right angles to that plane, amounting to four times 1½°. The forces affecting the earth cause it to change its position relative to the Sun, amounting to four right angles in the direction of its equatorial plane, while they cause a change at right angles to that plane, of four times 23½°. The forces affecting the Sun cause it to change its position relative to its ruler (Sirius?) amounting to four right angles in the direction of its own equatorial plane while they cause a change at right angles to that plane of four times — degrees.

Let us look at Jupiter and Saturn; these have systems not unlike the Sun. Jupiter has four satellites. The nearest one revolves nearly in the plane of his equator, the next a little more out, and so the next; the farthest satellites having the farthest range. So of Saturn's rings and satellites. The rings revolve in the plane of his equator; the satellites nearly in that plane; having range from it according to their distances.

So of the Sun, and its subordinates. Mercury revolves nearly in the plane of the Sun's equator, while larger latitude is allowed to the orbits of the more remote planets. All this warrants us in expecting to find the Sun moving in a direction not far from the plane of its own equator. I do not propose to settle with precision either the direction toward which the Sun is moving or its rate of motion. I leave this for the astronomer and the mathematician, neither of which

I claim to be. I believe if they will resort to diagrams and mathematics, astronomers have the data for determining both of these with the utmost precision.

On Plate II we have a representation of the moon in its revolution about the earth. All will admit that the moon makes its revolutions after this manner. May we have some analogical reasoning here? "The science of astronomy had its origin in the study of the moon." Were it not for the moon astronomers would have been left to grope in comparative darkness. It is doubtful whether even the law of gravitation would have been discovered. If the moon has been so useful in suggesting truth in other directions why not look to it for a hint on *the anner of effecting revolutions?* Better do this than make the moon an oddity in the planet family, as some are disposed to do. Surely the moon is none other han a satellite. It makes its revolutions very much as does the outer satellite of Jupiter. So it would appear if seen from Venus or Mercury.

I must insist that the planets make their revolutions with reference to their ruler, the Sun, very much as the Moon does with reference to its ruler, the Earth, Then, as the Moon only seems to move around the earth, so the planets only seem to move around the Sun. In their movements through space the earth and moon pass and repass each other, thus giving the appearance of movement in an orbit. So, in their movements through space, the earth and Sun pass and repass each other, thus giving the appearance of movement in an orbit. So, I suppose, in their movement through space, the Sun and Sirius pass and repass each other, thus giving the appearance of movement in an orbit. So, like the old astronomers in relation to the earth, we have been taking the apparent for the real. I am compelled to believe that all the spheres of the system are moving in the same general direction: A law of supremacy and of subordination giving to each the path in which it is to move; that in most cases, what we call the orbit is formed, the one half by the faster movement of the subordinate sphere; the other half by the faster movement, relatively, of the ruling sphere. They pass and repass each other, and out of that comes our revolutions.

Some one asks, "What then becomes of Newton and Kepler?" The laws that Newton discovered will take care of themselves. And they will be found to apply nowhere more beautifully than in the theory of movement here presented. As to the first and second of Kepler's laws, they are in a sense true. They are true if you speak only of something which is *apparent.* The first law is, "The planets move around the Sun in elliptical orbits." In the same sense in which this is true of the moon and earth, it is true of the planets and the Sun. Turn to the diagram on the moon's revolution, Plate II, and there define your idea of *moving around*, and of *orbit;* but especially of moving around. There you see in what sense this is true and in what sense it is false. In the primary meaning of these words it is not true. And the *moving* around is as ideal as the orbit. But the law is true of the *relative positions* of the planets and the Sun during apparent revolutions. In *relative position* we have the conditions of an ellipse, a revolution, an orbit.

Kepler's second law is that "the radii vectores pass over equal spaces in

equal times." Here we want definiteness of idea. To regard this as true of the real movement of a line joining the Sun and planet is very far from the truth. But, if we ignore the movement of the Sun, and ignore the real movement of the planet, and take account of the apparent movement the law is true. That is, it is true of the *angular velocity* of the planet. But its angular velocity is one thing, and its real velocity is quite another. Its angular velocity is never the same as the real. It is sometimes in a direction the very opposite of the direction of the actual movement. As velocity in the prime sense it is all apparent, at certain times.

As to Kepler's third law, the theory of movement here presented enables us to see why "the squares of the times are to each other as the cubes of the distances." We see at once how this law results from two others: the law of falling bodies, and the law of attraction. First, in each quarter of a revolution a certain amount of gain is to be made, viz: the distance of the planet. This gain is to be made by a constant increase, or diminution, of velocity, according to the law of falling bodies—$t^2 = \frac{2d}{g}$. From this we get $t^2 : t'^2 \therefore \frac{d}{g} : \frac{d'}{g'}$. But this gain is made according to the attracting force—gravity. And, $g \propto \frac{1}{d^2}$. From this we get the proportion $g : g' \therefore \frac{1}{d^2} : \frac{1}{d'^2}$. Combining these two proportions we have Kepler's third law. $t^2 : t'^2 \therefore d^3 : d'^3$.

I submit this simple exhibit of *the why* of this wonderful law in confirmation of my position. And I submit in confirmation of my position that here we have all we want in explanation of the cause producing and continuing the momentum —and the centrifugal force. Here it is all explained. I submit in conformation of my position that as the satellites are not so much under law to the equators, as to the paths, and to the orbits of their rulers, we are to expect such a general forward movement as permits a degree of constancy with reference to the paths.

The diagram gives us a new base of observation for studying the cause of the precession of the equinox. Also for studying the causes for the revolution of the perihelion and aphelion; and for *variations* in *apogeal advances* and *regressions*. It gives us a new base of observation for studying the plane of the ecliptic, as a plane of relative position. And as all orbital planes are similar in this respect, we may have a better understanding of orbits, and of forces determining them. It is only where we distinguish the apparent from the real, in movement, and in velocity, that we can rightly estimate the varying momentum which has so much to do in all these matters. The momentum that determines the elipticity of orbits. That determines the direction of the major axis; and that determines the variations of orbital inclinations. And now we are in a better position to look after the law which determines the axes of the planets, and so the equators, and to get a clue to the secret cause of the diurnal revolutions. A careful study of this whole subject, will reveal that none of the revolving bodies move in a plane; but that in addition to the deflection causing the revolution; there is another deflection causing inclination of the orbit of the inferior, as referred to the orbit of

its superior; and this grows out of momentum and attraction, *like the swinging of the pendulum.* For example, whenever the moon gets to either side of the plane of the ecliptic, the tendency of the attractive force, both of the earth, and of the Sun, is to bring it back to that plane. But its momentum causes it to go *so far out,* before it is overcome by these forces. Then it swings back as the result of the attracting forces. Thus this north and south movement is a sort of oscillation. The plane of the ecliptic being to the moon what the gravity-centre is to the pendulum of the clock. In each case we have momentum acting against gravity. Momentum carrying it beyond, attraction bringing it back. And so doubtless in their revolution *all the planets oscillate across the orbit of the Sun.* Astronomers must study the Moon in this light, learning its real and its relative velocity in all parts of its path, before they can fully master the problem of *the causes* of its varied movements. And here they may seen farther than has yet been done into the causes of *nodal regressions, and of their differences at different times.*

Discovery has not yet reached its limit. Nor has the process of eliminating errors in astronomical science yet been perfected. The coming astronomer has a grand field before him.

This paragraph is only added because of the dogged persistence I have seen among certain college professors. They are fond of the old illustration of the man walking around some object on a sailing vessel. One especially likes to illustrate the revolution of the earth around the Sun, by a race-horse running in a circular track, making a revolution around a stake at the center. They find in their books much learned bosh, and it is their habit to give it out to their students. How can it be otherwise when dealing so much with the apparent as though it were real. These illustrations are misleading. The cases are not analogous. To make it analogous, the central stake should have a movement on the surface of the earth, having the same relation to the moving horse, that the movement of the Sun has to the moving earth. Then your race-track would not be circular, but like that given to the earth in these diagrams, Fig. 1. But the learned professor will say, we may ignore all movement except that which is relative. And then, he not only does this, but goes on to *ignore the difference between the apparent and the real.* If pressed somewhat, he finds shelter under the declaration that "there is no such thing as absolute motion." Two students, Brown and Jones, having two yards of elastic cord, attempt while walking, to make a revolution, as the moon does around the earth. Brown represents the earth, and walks in the the middle of the road. Jones represents the moon, and makes the revolution. After walking thirty rods or more, all the time carefully honoring Kepler's laws, with Brown moving on at a steady gait, they have made three-fourths of a revolution. Jones says, "how far have I traveled?" Brown answers, "just three-quarters of a revolution in an orbit with a radius of two yards." But Jones wants to know something about movement over the road. Brown tells him that "in astronomy we ignore the road," that "all movement is relative." Jones is not satisfied. he has certain ideas about the ground passed over. But Brown, like a

good student, tells him "there is no such thing as absolute motion." It is evident that in order to give a diagram of the performance of these two boys we would have to be precise in dealing with the road. Road-measure here would be a reality, whatever becomes of the dogma that all motion is only relative. And if Jones was carried by an external force, which you were trying to understand, it is not likely you would succeed, if you persisted in ignoring space as measured on the road.

If told that the opening among the stars in Hercules shows that the Sun is moving in a certain direction, the answer is that in astronomy the apparent is often other than the real. These openings show a diminution of distance; but how effected, is another question. The man who will study this question in the light of diagrams will not for one moment concede that the solar system is moving in that direction. A difficulty more formidable to the writer arose from the reputed direction of the equator of Venus. All the text-books gave to Venus an inclination of axis, which if true, was incompatible with my theories. I felt obliged, either to surrender much of my ground, or to claim that all the text-books were wrong as to the direction of this equator. Seven years ago, I boldly took the ground that the text-books were wrong, and that the plane of this equator would be found but little removed from that of our own. It was with no little pleasure that in reading the lectures of Prof. A. C. Young delivered last year in New York, I found this declaration with regard to Venus. "As to the direction of its axis we do not know anything. And I say that because you will find it stated in many text-books that the axis is inclined at an angle of some 70° or 80°. I don't think we know that. I am quite sure we do not." So, with me, that trouble is over; though my confidence was such that it gave me very little trouble.

The writer will not be surprised if some errors will be found among the many things here suggested. But he is confident that the main things set forth in this paper will be found true; and that they have an importance far beyond what most people will be ready to ascribe to them. Much that he was disposed to say here has been ruled out, lest damage should come from admitting the doubtful. If this much is established, what is in reserve will naturally follow. For the most part, its unfoldment will require more mathematical knowledge, and astronomical research, that the writer has attained to. The whole is given over to the builders of the new astronomy, with assurance that some coming man will crown himself with honor by a farther pushing out in these directions. That man has my benediction.

ENGINEERING.

THE IMPROVEMENT OF THE MISSISSIPPI RIVER. — BOTH SIDES OF THE QUESTION.

I. THE LEVEE SYSTEM.—At a late meeting of the St. Louis Civil Engineers' Club a paper upon "Protection of the Lower Mississippi Valley from Overflow," was read by Mr. J. B. Johnson, of which the following is an abstract:

The extent of the overflowed region is 20,000 square miles. The great floods always come out of the Ohio in the early spring, and are likely to increase in size and frequency as the country becomes more generally cleared and drained. There were five parties in the field for the River Commission taking daily observations for discharge for the whole of the year 1882, four of which were below Cairo. The results of these observations are now published, together with observed discharges over the banks and through the swamps for the flood of that year. If all the overflow water had been confined to the channel, the channel discharge would have been increased on the upper portions of the St. Francis front by 12 per cent, along the central portions by 50 per cent, along the lower portions and upper part of the Yazoo front by 25 per cent, along the central portions of the Yazoo front by 90 per cent, in the vicinity of Vicksburg by 25 per cent, at Red River by 20 per cent, and at New Orleans by 100 per cent of the amounts that actually did pass in the channel at these points.

Four methods of treatment were presented:

1. To have no levees whatever and let the water find such natural outlets into the swamps and finally into the Gulf as nature had provided. This method of treatment would result in the abandonment of this region by the better classes, since agriculture could not be made profitable. It was thought, however, that with the present excessive variations in the width of the channel this method of dispersion was really in the interest of low-water navigation. The gist of the argument on this question seemed to be that since the bars are all formed at high stages, and the higher the stage the higher the bars are built, so, any addition to the high stages by means of levees increases this bar-building influence. In high stages the river always scours in the deep places and fills on the shoals, which is exactly the reverse of what is desired.

It was shown that the bars were caused by the inordinate variations in the velocity of the water at successive sections, owing to the great changes in width. Bars are wholly formed by the deposit of sand which had been in temporary suspension for a few miles, coming from the first deep pool above. The variations in velocity, causing these deposits, are enormous, being on the Plum Point reach as much as 6 feet per second (from 10 feet to 4 feet mean velocity). The remedy is in contracting the channel in the wide places and not in building levees.

The second systen of protection is that now in vogue, or levees high enough to hold ordinary floods, but great floods always breaking through them. This is both expensive and unsatisfactory. It is a protection that costs millions of dollars and yet does not protect.

The third method is to build the levees high enough and strong enough to stand the greatest flood that would likely come upon them. As to the heights the flood would have reached had the water all been confined to the channel, the estimates of Gen. Comstock, President of the Mississippi River Commission, were taken and are as follows:

At Columbus, Ky., there would have been added 200,000 cubic feet per second to the channel discharge, giving an increased height of three feet. At Fulton, Tenn., with 600,000 cubic feet to be added, the increased stage would have been 10 feet. At Helena 360,000 cubic feet would have been added, giving an increased stage of four feet. At Lake Providence the discharge of 1,000,000 cubic feet would have been nearly doubled, giving an increased stage of 10 feet. At Red River Landing there was 1,600,000 feet passing in the main channel, 300,000 cubic feet passing in the Atchafalaya, and 300,000 more passing overland. If this amount of overflow water were divided proportionately between the two streams it would raise them both three feet.

At New Orleans the maximum discharge was 900,000 cubic feet per second. If the discharge at Red River of 1,600,000, increased by 200,000 cubic feet of overflow water, were all confined below that point the discharge at New Orleans would be doubled. The increased height of the water is somewhat uncertain, but it would probably be about 10 feet.

The mouth of Red River is probably the head of the Delta, and an effort now to confine all the water to one or two channels will demand enormously high levees. And yet Captain Eads resigned his place on the commission because they declined to close the Atchafalaya entirely, and so deprive that part of the river of this partial relief. The increase of stages given are all so much above the high-water marks of 1882.

Levees calculated to confine the greatest floods must be on an average sixteen feet high where there are now none, and all levees now built must be raised on the average by eight feet. The cost of a proper levee is $50,000 per mile, which means a total expenditure of some $50,000,000 to confine such a flood as that of 1882 to the channel from Cairo to the Gulf, allowing, also, the Atchafalaya to discharge its full capacity.

The River Commission has estimated $11,000,000 for this work. This low estimate is the occasion of Gen. Comstock's exceptions to the report.

The third method of protection is more feasible. The features of this system are moderate-sized levees, or such as will keep out all moderate or ordinary floods, or such levees as are now found. Provision made for the discharge over these levees of the excess over the channel's capacity, in case of high floods, without injury to the levee, and provision for the conveyance of this flood overflow back to the channels of the bottoms. Levees of this size would probably furnish com-

plete protection four years out of five. When they are insufficient, the excess must be allowed to pass the line of the levee by weirs with revetted slopes, so that the water can be safely transported without injury to the levee. This system has been succesfully employed in France. To discharge 1,000,000 cubic feet per second with a three-foot depth on the weir would require a weir about eleven miles long. The weir must be located where the facilities for carrying off the water are best, or in the vicinity of the old natural outlets from the channel to the swamps. There are many such natural outlets, some of large size, such as the Yazoo Pass. These would only required to be cleared and they would then enlarge, as the Atchafalaya has done, and so this overflow water might be transported away from the river bank without flooding the plantations. When the water escapes over the banks now it must find its way through tangled forests and canebrakes as best it may, and the result is it rises till it includes all in one vast inland sea, and stands as high behind the levee as in front of it. This method of protection is deserving of the attention of the Commission and should be carefully studied.

II. THE OUTLET SYSTEM.—Capt. John Cowdon, of New Orleans, whose name has been made prominent as the projector of the Lake Borgne outlet plan, for the improvement of the low water navigation of the Mississippi River and tributaries, and the reclamation of the valley lands from overflow without the use of levees, spent several days last month in this city in the interest of his projected enterprise. He holds that Kansas City, being in direct communication with the Mississippi River below flood lines via the Kansas City, Springfield & Memphis Railway, has more commercial interest in the success of the Lake Borgne outlet than any other western city, and on his way from New Orleans here was particularly struck with facilities of the Memphis line as a medium of commercial communication between Kansas City and the Mississippi River.

We condense his views as given in the Kansas City *Journal:*

He regards this road as the most important one for this section of the country ever built, for the reason that it, more than any other route of transportation, penetrates the Southern States, striking the Atlantic Ocean at Brunswick, Ga., and crossing the Mississippi River below the ice gorge and shoal water, and when the Mississippi may be opened with a thirty-foot channel that ships can find, it will require two double track roads to do the business that will then seek the Southern commercial outlets.

A considerable portion of this road runs through the bottoms and overflowed lands of the Mississippi, and, not only the St. Francois bottoms are overflowed but the entire valley, from Cairo down to the Gulf, rendered comparatively worthless. If authority can be obtained from Congress during the short session to make the Lake Borgne outlet at private expense, asking nothing of Congress until the work is accomplished, it will reclaim that entire valley from overflow the first year, and the value to the Kansas City and Memphis road alone would be hundreds of millions of dollars.

To show how the outlet plan would operate he referred to some engineer-

ing facts obtained from the highest authority in this country, which show the absurdity of all other plans and the feasibility of this one. General Humphreys, the old chief engineer of the United States Army, who spent ten years examining the Mississippi River, making the most elaborate report ever made by any one, says that the approximative fall from Cairo to Memphis is five inches to the mile, for a distance of 200 miles, while we all know that the current is fully five miles per hour. For the last 200 miles of the river (from the mouth up) the approximate fall does not exceed two inches to the mile and the current is only about three miles an hour. This of itself shows that the water runs in faster at the upper end of the river than it runs out at the lower end, and the more levees they build the less angular fall per mile, which in consequence makes the water run slower and is the real cause of overflows. Upon the same principle, the more levees the greater the overflows.

By the plan of the Lake Borgne outlet the flood waters of the river reach the Gulf in going five miles instead of 120 miles farther by the natural way of the river, which will lower the flood line at New Orleans in the course of a couple of years, or in other words will restore the same condition of water levels at that point as when the mouth of the river was there, which was fully fourteen feet below the present flood line. As a natural consequence this will restore the flood lines of that period all the way up to Cairo, which were from twelve to twenty feet below the present flood lines, doing entirely away with the necessity for levees, and at the same time, confining within the natural banks of the river the waters of the entire valley, which will in high as well as low water wash out its bottom, confine the water and deepen its channels. The trouble is with all of these educated scientists, they appear to never have understood in this great problem that there was a Gulf of Mexico, the only place capable of emptying the Mississippi River, or they certainly would have considered the necessity of getting the flood waters of the Mississippi River and valley into the Gulf by shorter and quicker routes than by the natural course of the river itself.

By this plan the waters of the river are confined, while the River Commission maintain that they spread out and overflow the country. But they don't understand the difference between an outlet and a crevasse, for if the Lake Borgne outlet is made there will be no crevasses, and if there are no crevasses there will be no overflows. For an outlet, such an one as Lake Borgne, takes the floods from river direct to the Gulf and relieves the river of all its flood waters, while on the other hand a crevasse is a place where the levees break, flooding the back country and returning to the river again at some point below, affording no general relief.

The closing of Bonnet Carre crevasse raised the water in the river higher than ever before at New Orleans and in the lower section of the river, and the relief was only found by the breaking of a levee on the west bank of the river between New Orleans and Bonnet Carre which overflowed the parishes, causing a loss of fully $10,000,000, ruining a great many people and rendering their land incapable of producing a crop for another year. All this loss of property has

been caused by the River Commission and its friends who want to close all outlets and build levees.

The consummation of the outlet plan upon New Orleans would be that in the first place it would drain the entire valley from overflow, giving that city the products of nearly all the land in the valley below Cairo, which would amount to hundreds of millions of dollars annually. Second, the flood line of the river being lowered fully fourteen feet it would make that city high and dry, and render a system of sewerage possible which would entirely free that city from yellow and malarial fevers, which would do away with the quarantine except as at other cities, which now operate detrimentally to her commerce. When New Orleans is properly sewered and has such sanitary regulations as other cities enjoy, the yellow fever and other epidemics will not spread there any more than in New York and other northern cities. There is no doubt that New Orleans has degenerated very greatly within the past twenty-five years as a commercial centre, as compared with other cities, owing to her epidemics and her lack of a deep outlet uo the sea. As an evidence, in 1860 the cotton crop of the United States was 3,200,000 bales, of which New Orleans handled 2,200,000 bales. The crop now is 6,500,000 bales, of which New Orleans does not handle to exceed 1,700,000 bales. Then of the tobacco crop produced in the country in 1860, New Orleans handled 88,000 hogsheads, and now, when the crop is fully three times as large, she does not handle 10,000 hogsheads. Then in 1860 New Orleans imported 22 per cent of the entire imports of the United States, while at present her imports do not exceed 2 per cent. At that time New Orleans imported 80 per cent of the coffee consumed in this country, and now out of 200,000,000 pounds imported annually she handles less than 20,000,000 pounds.

"As another fair illustration of this decay, when I was in New Orleans a few days ago I saw but two steamers loading for foreign ports, and but three or or four sailing-vessels at the wharves, while twenty-five years ago I have seen 200 sailing-ships and from fifty to 100 steamboats at the landing at one time loading and discharging cargoes from all portions of the world. Now there are to be seen only a few local packets. The fact is that fully 90 per cent of the commerce of the Mississippi valley which should go to New Orleans now goes off east by the railroads. The people of the great northwest and especially of Kansas City, are as deeply interested in the prosperity of New Orleans, the reclamation of the valley lands of the Mississippi; an improved river and opening of a deep outlet for your commerce to the Gulf as are the people of that city and valley themselves. For with these things accomplished it will place your grain in Liverpool for fifteen cents per bushel, while it now costs you thirty cents to New York, and this in a nut-shell explains the reason why so many plans are adopted in order not to improve and open that river, and is the secret of all the opposition to what we propose to accomplish by the Lake Borgne outlet and auxiliary work."

EDUCATION.

TECHNICAL INSTRUCTION IN EUROPE.

F. G. FRENCH.

(*Translated from the German of Dr. Herman Grothe.*)

The various efforts made at the present time to educate the young in some skilled handiwork have led the German Society for the Advancement of Industries (Verein zur Beförderung des Gewerbefleisses) to establish a commission with the object of inquiring what branches of industrial training are carried on in the different special schools, and workshops connected with schools, in Germany and neighboring countries. The following is taken from the report of Dr. Hermann Grothe, Honorary Member of the "Central verein der Deutschen Wollenwaaren-Fabriksanten," on the subject. In France an intermediate grade of industrial training is given at the Schools of Arts and Trades at Chalons, Aix and Angers. These three schools have regular workshops and rooms enough for 900 pupils.

Lately several industrial schools or higher commercial and industrial schools have been started. For instance at Limoges there is a school of ceramics; at Lille one for spinning and weaving of linen; at Nevers one for iron-work; and at Roubaix one for weaving. The Central School of Arts and Manufactures and the Conservatory of Arts and Trades in Paris give a higher grade of technical instruction. In addition to the national special schools for this grade of work there are in France numerous communal and private institutions of a similar character, such as the Delahaye Institute, the Springer Institute and the Communal School of the Rue Tournefort in Paris, and the Institute of Our Ladies at Nantes. The Martinière school in Lyons belongs to a still lower grade. This one, with some other schools of arts and trades, or higher commercial and industrial schools, is in part preparatory to the State institutions. Several schools have now a special organization, thus the National School for watch and clock-making at Cluses, the School of Textile industries at Epinal, the Higher Industrial School at Rouen, the Industrial Institute for Flax-spinning at Lille, the School of Industrial Arts at Roubaix, the Weaving School at Lyons, the Lace-Work Schools at Dieppe, Creuzot, Bayeux, St. Brienne, etc., that for willow-culture and basket-weaving at Origuy-on-the-Thou, those for stone-cutting at Clermont, Ferraud, Grenoble and Neinlly-on-the-Seine, with others for cabinet-making, furniture manufacture, type-setting and paper-making. Certain orphan asylums also have workshops connected.

In Belgium there are no institutions for technical education of a secondary grade. But in 1879 there were thirty-two industrial schools reported which

aimed to give working-men a higher theoretical education. There were also fifty-nine workshops for apprentices, and numerous drawing-schools.

In Italy the government has seen to the establishment of over fifty work and industrial schools (scuole professionale, industriale.) These have 20,000 pupils, are situated in rural districts, and receive aid from the Ministry of Agriculture and Commerce. There are also art schools for drawing and modeling, several professional schools for women, and many advanced schools and private institutions under the charge of certain societies. For higher technical instruction there are regular technical institutions, some provincial, others communal. Among these are naval and technical schools in sea-port towns. At the exhibition in Milan in 1881 there were sixty-seven of these making some exhibit.

The Netherlands report professiona! schools (Ambachtscholen) at Amsterdam (since 1861), Rotterdam, Arnheim, the Hague, Groningen and Utrecht. Among higher grade institutions are the Machinists' School at Amsterdam, and the Academy of Arts and Sciences at Rotterdam.

In Spain the elements of agriculture, the arts and industries, commerce and seamanship are taught. The higher technical schools cover engineering in all its phases, and there are six land-surveying schools.

Portugal had up to 1873 only two theoretical-technical schools—at Lisbon and Oporto. In connection with the latter was a workshop for mechanicians where the most accurate instruments were tested. The death of Fradesso da Silveira, Director of the Polytechnic School at Lisbon, put a stop to any reforms in that institution.

In Russia higher technical schools are represented by the technical institute —dating from 1825—at Moscow; the Institute of Technology at St. Petersburg, which dates from 1831; the Technical School at Helsingfors (1847); and the Polytechnic—from 1861 or 1862—at Riga. There are also many institutions, with workshops attached—for a lower grade of industrial training. The Polytechnic museum at Moscow, and certain industrial art schools come into the list of technical departments. The Polytechnic School at Riga, which is organized like similar institutions in Germany, had about 700 students in the summer term of 1884. Thirty-six followed the course in architecture, 175 that of mechanical engineering, and 183 the chemical-technical course. The income at present is 45,000 roubles (65.8 cents to the rouble). A new and large laboratory is now in process of erection. The professors are about equally divided between home and foreign talent.

In Sweden and Norway efforts are being made to advance the educational status of laborers and workingmen generally, by means of handiwork and needlework schools. Household industries are also taught in evening and Sunday schools. At Gothenburg there are twenty-one workshops where 1,600 children are under instruction, and near the city is an extensive manual training school. In Stockholm household industries are taught in connection with the common schools. Nearly all the cities of Sweden have schools in which industrial training is given.

Denmark has a Polytechnic Institute at Copenhagen, as well as a school for a lower grade of technical instruction. Since 1873 numerous handiwork schools have been started at the suggestion of Clauson-Kaas.

Switzerland gives a high grade of technical instruction at the Polytechnic School, and a lower grade at several industrial institutions where, however, there are no workshops. Several handiwork schools are also reported.

Austria-Hungary has technical schools at Vienna, Prague (2), Brünn, Gratz, Lemberg, and Pesth. The national technical-industrial schools are all fully equipped special schools. Among the secondary technical institutions the technological museum in Vienna holds first rank. The special schools which receive State aid are very numerous. There are namely twenty-nine for bobbin-lace work, embroidery, lace-making, and weaving; twenty-two for wood and stone-work; six for ceramics and glass industry; seven for working in metals, and five for different kinds of work—in all sixty-nine.

Germany has higher technical institutions in Berlin, Hanover, Aix-la-Chapelle, Dresden, Münster, Stuttgart, Brunswick and Carlsruhe. The twenty-four provincial industrial schools established by Beuth in Prussia have come to naught. In Barmen a high and lower grade technical-industrial school was founded in 1863. At Crefeld a higher textile school was established. In Remscheid and Iserlohn there are special schools for metal and bronze-work, in Montaban near Wiesbaden ceramic schools, in Heinsberg (Aix-la-Chapelle) workshops for basket-weaving, in Glashütte a watchmaker's school. There are also several private building schools and advanced schools (Baugewerk schulen and Fortbildungs schulen); in all 213 technical-industrial schools.

An institution for general industrial training at Hamburg has a school for builders connected with it. Saxony possesses industrial art schools in Dresden and Leipsic, twenty weaving (Web und Wirkerei) schools, thirty-one lace, needle-work and embroidery schools, three for spinning, two for wood carving and working in wood generally, three for straw-plaiting, one for lead-workers, one for instrument-makers, one for watch-makers, two schools of music, four ship schools, and numerous drawing-schools. Middle grade technical-industrial instruction is given in five schools for foremen (Werkmeister schulen), and in a higher grade technical-industrial school in chemistry. A still higher class of work is found in the Polytechnicum at Dresden. The Duchy of Saxe-Coburg-Gotha reports builders schools at Gotha and Coburg, and basket-weaving schools or workshops scattered throughout the Duchy. Greitz and Gera have schools for weaving, Brunswick an important school in connection with the Society for the Advancement of Industrial Arts. At Holzminden there is a builder's school (Baugeewrbe-schule). Schwerin has a similar school, and Mecklenburg has a fishing-school at Wismar.

Wurtenburg carries on industrial training by means of itinerant teachers, various societies, a central organization, and in 153 industrial review-schools. Baden gives a high grade of instruction in the polytechnicum at Carlsruhe, and a lower grade in forty-four technical-industrial schools. At Carlsruhe there are

both industrial-art and architectural schools. The Grand Duchy of Hesse has forty-eight handiwork-review schools, a school of architecture or builder's school, and a polytechnic school at Darmstadt. Bavaria has in connection with her industrial-review schools 251 vacation schools, also forty-five district industrial schools and many special schools. Higher middle-grade instruction is given in four Industrie schulen. Alsace-Lorraine gives technical training at Mühlhausen, while Strasburg has a winter school for architects, and a skilled handiwork school.

HISTORY.

LOUISIANA—HOW LOST TO THE FRENCH.—A SKETCH.

OSCAR W. COLLET.

The old French and Indian war, begun in 1754, intimately effected the destiny of Louisiana, although her soil was not invaded. As one of its results the Valley of the Mississippi was dismembered and the west half thrust upon Spain—an unwillingly accepted gift. Nova Scotia and Canada, the vallies of the Ohio and Mississippi, and the lands of far west, even to the shores of the South Sea, as they called the Pacific, belonged to the French, or were claimed as theirs. To protect what they actually possessed and support their pretensions, to secure safe intercommunication between the north part of their possessions and the south, and constrain the English to confine themselves to the eastern slopes of the Alleghany Mountains, a series of defensive works was designed, extending from the Mississippi to the Lakes.

Land hunger on the part of the English, large grants north of the Ohio, restlessness of backwoodsmen, the eagerness of the rivals to monopolize the fur trade, and national antipathies and prejudices, mutually fostered, were among the causes of this war—a war so destructive in the event to the interests of one of the combatants.

Unity of direction, concentration of population at a few points, military spirit and military habits, and the friendship of the Indian tribes who inhabited the western wilderness were on the side of the French, though inadequately compensating for the disparity of numbers between them and their rivals. All told, their continental possessions contained scarcely sixty thousand souls, whereas the English colonists were estimated at more than a million, besides their alliance with the Iroquois, the most formidable by far of all the northern savages, and especially favorably situated to co-operate in any movement directed against Canadian posts, or the regions of the upper Ohio River.

The English who ventured westward were seized and imprisoned; the Vir-

ginians resented the act, dispatched forces across the mountains under Washington, who at first was successful and then forced to capitulate. Fort Duquesne was built where Pittsburg now stands. Braddock arrived in 1755 with an army, and with auxiliary troops marched westward to attack the Fort. Expeditions against Crown Point and Niagara were planned. Nova Scotia was invaded, the Acadians were overcome and ruthlessly transported to different points in the English colonies. Braddock was defeated with great slaughter. The expedition against Niagara was unsuccessful, that against Crown Point more favorable to British aims.

War was formally declared in 1756. Oswego was taken by the French.

In 1757 Fort Henry capitulated to Montcalm, and the victory secured him complete possession of Lake George. The general result at the close of the year, although large reinforcements had arrived from England, was disaster and defeat.

In 1758 the influence of William Pitt at the head of the British Government was felt in America, and the English commandant, General Abercrombie, was enabled to count upon an aggregate force for the prosecution of the war, of 50,000 men, two-fifths of whom were colonial troops. Three expeditions were planned, against Louisbourg, Ticonderoga and Crown Point, and Fort Duquesne. The first was taken; the second successfully resisted; and the third, after some temporary advantages over General Forbes, who led the attacking column, was abandoned and burnt. The new post that arose upon its ruins was thereafter known as Fort Pitt.

In 1759 Ticonderoga and Crown Point were evacuated by the French, and Sir William Johnson captured Niagara. Wolf attacked Quebec, was killed, as also its defender, Montcalm; the city surrendered.

Face to face the giants stood, a death struggle at hand, an empire to be lost or saved. Note the contrast.

England was governed by the greatest and most masterful of all the distinguished ministers she had ever had, who wielded the resources and the power of a mighty empire with firmness, and vigilance, and vigor, and undaunted perseverance, to the crushing of a rival nation, to this end sacrificing all else and constraining all interests to contribute.

On the other hand, France was under the rule of the miserable Louis XV, as degraded a prince as ever sat upon a throne, whose ambition a new mistress, whose aim in life the gratification of lust, whose companions gilded harlots, whose estimate of money its power to minister to groveling pleasures. Little cared he for success or failure, victory or defeat, honor or dishonor, so long as his ignominious enjoyments were not interfered with; and the revenue of his kingdom, which should have been husbanded to sustain the mighty contest in which the nation was involved, was wasted upon minions that pandered to his vanity, fattened on his vices, took part in his orgies, or gave up their bodies to gratify animal passions so vile and so fierce as to increase with indulgence and know no satiety. Such a thing deserved not success.

In 1760 the combined English force laid siege to Montreal; and in September the stronghold capitulated. The fall of Montreal practically ended the war, as its surrender carried with it that of all Canada, including the posts and forts within her jurisdiction, and left Louisiana at the mercy of the conqueror.

The peace of 1763 terminated ingloriously the continental domination of France in North America. Her feeble grasp was relaxed of a domain the most remarkable, the most valuable, and the most extensive any nation ever possessed since the universal empire of all conquering Rome. The Canada that was known, the northern streams and lakes and the lands they watered whose extent had not been measured by discovery, the vast territory beyond the Mississippi to the far-off ocean, the Louisiana that Marquette had given to France and LaSalle explored, of itself a noble heritage for generations unborn, were lost forever.

The causes of this overwhelming disaster that lie on the surface were: *First*, the relative position of the contestants; a huge semi-circle would roughly represent the line circumscribing their respective countries—the English inside, the French on the circumference. *Next*, disparity of numbers, nearly twenty to one in favor of the British. *Third*, the energy and activity of the English Government which sent large reinforcements to the colony and urged on the war with a determination to overthrow their opponente forever, whereas but feeble aid was sent by France. *Fourth*, the wretched system of government imposed upon Louisiana, and the policy of the mother country in her regard, from the very start, under which it would have been a marvel had she prospered and grown strong, and been in a condition to organize formidable flank movements in time of need, against the western borders of the adjacent colonies.

Looking at results in the light of more than a century's experience, suggests the thought that possibly it would have been better had France either been completely triumphant and possessed the land exclusively with an abundant population, or never attempted to colonize the wilds of the West and South; for somehow the Franco-Canadian population found in the valley when the French domination ceased, and later when the trans Mississippi regions were purchased by the United States, has seemed rather overwhelmed by numbers, than absorbed or assimilated by the dominant race. It has maintained its individuality in manners, and customs, and spirit, and to some extent its native tongue; and its ideas and its life seem to lie outside the Hiberno-Teutonic-Anglo-Saxon population which in this century has spread over the land.

For the monuments of the ancient population we look in vain. Where, undispersed, it still vegetates in a few villages, chiefly along the water-courses, founded long ago, it is as its ancestors were when the Bourbon flag was lowered at the citadel of Fort Chartres—unchanged, impassive, a complete stranger to our nineteenth century ideas. A hundred and twenty years have passed, but it has stood still. It has enriched geography with names, and history with events, but suffered its missionaries and its martyrs, a noble band and its noblest representatives, to lie unhonored in forgotten graves, and the memory of its heroes to slumber uncared for in the chronicles of the past; and even as to these,

if Marquette, and Joliet, and LaSalle, and Bienville, and St. Ange, and others are not as dim and shadowy forms, it is not the primitive population of the valley that has revealed them to us as realities. If we look abroad over the face of our earth where men congregating have formed towns and cities, what is there that witnesses to the presence of the race, either collectively or individually, that once possessed the land and still lives in its descendants. Their memorials may be counted upon less than the fingers of one hand. With not one single important work of education, art, science, culture, benevolence, or religion are they associated. Rich or poor they acknowledge no claim upon them as citizens in regard to such works, and pass them by with indifference as matters in which they have no concern.

Franco-Canadians discovered the Valley of the Mississippi, missionaries of the cross of their race led the vanguard of civilization into its savage wilds to dispense the blessings of religion to the red man and the white, and nature offered the advantages of a fertile soil, genial and diversified climate, and suitable waterways for commerce, with a lavish hand. An energetic population and good government were all that were needed that a grand empire should arise in the midst of the wilderness. But the rule of the Bourbon weighed heavy upon the land, and those that came to make it their home seem not to have brought with them the native qualities which characterize their race on the other side of the sea.

St. Louis, Mo., September, 1884.

METEOROLOGY.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

The record of meteorological observations for the month ending September 20th shows a continuance of conditions very favorable to agriculture. The last decade of August and the first of September were comparatively dry and by the 19th of September the streets in this vicinity were more dusty than at any previous time this year. A heavy shower on the morning of the 19th gave 2.29 in. of water. It is interesting to note that nearly all the heavy rains have occurred in the periods from midnight to sunrise this year and have come from northerly directions. At this date the foliage retains nearly all the freshness of midsummer, and the grass and weeds of late growth have had a remarkable development, owing to the long-continued abundance of rain.

The usual summary by decades is given below.

Temperature of the Air.	Aug. 20th to 31st.	Sept. 1st to 10th.	Sept. 10th to 20th.	Mean.
Min. and Max. Averages.				
Min	59.	62.	48.	53.
Max	94.	93.	94.	94.
Min. and Max	81.	77.	71.	76.
Range	35.	31.	46.	37.
Tri-Daily Observations.				
7 a. m.	69.7	73.8	61.0	68.2
2 p. m.	85.3	90.3	84.7	86.8
9 p. m.	71.8	75.7	66.1	71.2
Mean	74.6	79.9	70.6	75.4
Relative Humidity.				
7 a. m.	.81			
2 p. m.	.52			
9 p. m.	.84			
Mean	.74			
Pressure as Observed.				
7 a. m.	29.080	28.902	29.140	29.041
2 p. m.	29.042	28.875	29.089	29.002
9 p. m.	29.064	28.912	29.100	29.025
Mean	29.062	28.896	29.109	29.023
Miles per Hour of Wind.				
7 a. m.				
2 p. m.				
9 p. m.				
Total miles	2547	3658	2608	11713
Clouding by Tenths.				
7 a. m.	6.4	4.0	3.7	4.7
2 p. m.	3.9	2.4	3.7	3.2
9 p. m.	4.0	2.4	2.5	3.0
Rain.				
Inches	1.90	.19	2.33	4.42

BOOK NOTICES.

North American Aborigines. Report of the Peabody Museum, 1881.

It is gratifying to see that the latest report of the Peabody Museum of American Archæology and Ethnology is paying much more attention to the description of living nations and tribes than to the enumeration of the implements and classification of the dry bones of extinct and *nameless* populations. The study of *living* tribes is the principal key for archæologic research, and ought to be pursued with might by us as long as there are any genuine Indians living in North America. Archæology can never become a real science, unless we are enabled to assign the *true date* and *nationality* to the relics and finds stored up in our museums, and this aim can only be reached, if attainable at all, by studying the aborigines of our days. Impelled by this consideration, the author who furnished five articles for the 16th and 17th Report (Cambridge, 1884,) before us, has endeavored to transmit the impressions, as graphically as possible, which she received

among the Omaha and a part of the Sioux Indians. Miss Alice Fletcher has sketched in this manner the white buffalo festival of the Hùnkpapa, the elk mystery of the Oglála, the cult of the Four Winds among the Isángti, the ghost lodge of the Oglála and the pipe-dance of the Omaha. An article chiefly due to historic research is "on the social and political position of woman among the Huron-Iroquois tribes," by Mr. Lucian Carr, Assistant Curator of the Museum.

A. S. G.

COMPARATIVE VOCABULARIES OF THE INDIAN TRIBES OF BRITISH COLUMBIA: By Dr. W. F. Tolmie and G. M. Dawson. 8vo., pp. 127.

As the first result of activity shown by the newly organized ethnologic section of the geological survey of Canada, Alfred R. C. Selwyn, Director, an instructive publication has just been issued at Montreal under the title: "Comparative Vocabularies of the Indian Tribes of British Columbia," with a map illustrating distribution; by Dr. W. F. Tolmie and George M. Dawson, pp. 127, 8mo. Dr. Tolmie has been a resident in the northwest almost continuously since 1833; for many years he was in the service of the Hudson's Bay Company and through it was brought in contact with a large number of Indian tribes. Dr. G. M. Dawson is well known as a geologist, first by his report on the Queen Charlotte Islands (1878–9). The vocabularies embodied in the pamphlet before us number about thirty and were for the larger part collected by the two scientists in Victoria during the winter of 1875–6; with the exception of the Tinné and Haida dialects and the Kútenay, they embrace about 210 words each (the list of G. Gibbs), and are worded in an alphabet, of which the elements are explained on page 10. Some of the northwestern dialects, especially those of the Tinné stock are exceedingly difficult to render graphically unless the linguist has become previously familiar with them. The vocabularies contained in the volume are the following, the group to which they belong being premised to each group:

THLINKIT: Skut-Kwan.

TSIMSIAN: Kitunto, Kithātla.

HAIDA: Kaigani, Masset, Skidegate, Kumshiwa.

KWÁKIUL: Haishilla, Flailtzuk, Kwiha, Likwiltoh, Kowmook (or Tlathool).

KAWITCHIN: Snaraimu, Songis, Kwantlin.

A'HT: Kayukw-a'ht.

SELISH: Sinahomish, Staktamish, Lilloet, Kalispelm.

TSINUK: Tsi'nuk—proper, Tilhiluit.

BILHOOLA: Nuthlākimish.

TINNÉ: Tshilkotin, Nakuntlán, Takulli.

SAHAPTIN: Klikatat (or Whulwhaipum).

KUTENUHA: Upper Kutenúha.

This division is carried through the whole volume and also figures in the ethnographic map added to it. It correctly divides the tribes into groups, but if a purely linguistic division had to be attempted, the Kawitchin, Selish and Bilhoola would have to be united into *one* family.

A. S. G.

THE ORIGIN OF SPECIES: By Charles Darwin. Complete in two parts, 30 cents each. J. Fitzgerald, Publisher, 20 Lafayette Place, New York. For sale by M. H. Dickinson.

Darwin's great work, which has revolutionized the whole world of science and philosophy, is now for the first time published in a cheap edition, and brought within the reach of all readers. The present edition is printed in clear type on strong paper, and makes about 260 octavo pages, in double columns, containing the entire work as revised by the author shortly before his death, with the valuable glossary of scientific terms and the very detailed index. The work should be in the hands of every intelligent person who is interested in the current of modern thought.

THE CHILDHOOD OF THE WORLD: By Edward Clodd. No. 60 of the "Humboldt Library of Science." Price 15 cents. J. Fitzgerald, Publisher, 20 Lafayette Place, New York. For sale by M. H. Dickinson.

"The Childhood of the World" is a simple, lucid account of the origin and development of civilization, tracing the rise and progress of governmental institutions, religion, manners and customs, arts and sciences, from the earliest periods of the history of man upon the earth, in the light of modern scientific research. The fruits of the labors of Tylor, Lubbock, Max Muller, and other great scholars are presented in a form so attractive as to command the attention even of the most listless reader.

BOOKS TO BE NOTICED.

Legends, Lyrics, and Sonnets, by Frances L. Mace. Cupples, Upham & Co., Boston, Mass., pp. 227. $1.25.

History of the Republican Party, by Frank A. Flower, Springfield, Ill. Union Publishing Co., pp. 623.

The Home Physician, by Luther M. Gilbert, M. D. G. P. Putnam's Sons, pp. 131. $1.00.

Forestry of Northern Russia, by J. C. Brown, LL.D., Edinburgh, pp. 279.

Handbook of the St. Nicholas Agassiz Association, by Harlan Ballard, Lenox, Mass.; pp. 116.

Walls that Talk—Libby Prison, Richmond, Va. Published by the R. E. Lee Camp. 25 cents.

Catarrh, Sore Throat and Hoarseness, by J. M. W. Kitchen, M. D. G. P. Putnam's Sons, New York.; pp. 80. $1.00.

Forestry of Norway, by J. C. Brown, LL.D., Edinburgh, pp. 227.

Physician's Handbook of Pharmacy and Therapeutics, by James Lilly, Indianapolis, Ind. 50 cents.

Training Schools for Nurses, by W. G. Thompson, M. D. G. P. Putnam's Sons, pp. 57. 60 cents.

Protection to Young Industries, by F. W. Taussig, Ph.D. G. P. Putnam's Sons, pp. 72. 75 cents.

Smithsonian Report, 1882, Washington. Government Printing House.

Seven Decades of the Union, by H. A. Wise, J. W. Randolph and English, Richmond, Va., pp. 320. Cloth, $2.00.

Publications of Washburn Observatory of the University of Wisconsin, Vol. 2, Madison, Wis., pp. 400.

Department of Agriculture, Third Report of U. S. Entomological Commission, Washington, D. C.

Wisconsin Historical Collection, Vol. 9, Madison, Wis.; C. C. Washburn, President.

Smithsonian Report, 1881, Washington, D. C.; Spencer F. Baird, Secretary.

Report of U. S. Fish Commission for 1881, Part 9.

Signal Service Notes, No. 9, Weather Proverbs, by H. H. C. Dunwoody, Washington, D. C.

OTHER PUBLICATIONS RECEIVED.

Miscellaneous Papers on Anthropology, from Smithsonian Report of 1882, Washington; Government Printing House. Johns Hopkins University Studies, Herbert B. Adams, Editor; Second Series; Town and County Government in English Colonies of North America; The Toppan Prize Essay, by Edward Channing, Ph.D., Baltimore, Md. Bulletin of Washburn Labratory of Natural History, by F. W. Cragin, Vol. 1, No. 1. price 15 cents, Topeka, Kansas. Signal Service Notes, 16, Effects of Wind-Currents on Rainfall, by G. E. Curtis, Signal Office, Washington, D. C. Protection and Free Trade To-Day, at Home and Abroad, in Field and Workshop, by Robert P. Porter, price 10 cents, Boston; James R. Osgood & Co. Twelfth Cincinnati Industrial Exposition. Edwin Stevens, President. Railroads in Tennessee, Their War on the People, by John H. Savage. Circulars of Bureau of Education, No. 5, 1884, Washington, D. C. Catalogue of Books Published by Houghton, Mifflin & Co., Boston and New York, 1884. Literary Bulletin of Houghton, Mifflin & Co., September. Report of Kansas State Board of Agriculture for month ending August 31, 1884. Wm. Sims, Secretary, Topeka, Kansas. Seven Hundred Album Verses, compiled by J, S. Ogilvee, price 15 cents, J. S. Ogilvee & Co., publishers, New York. Johns Hopkins University Studies, Herbert Adams, Editor; second series 8–9; Indian Money as a Factor in New England Civilization, by Wm. B. Weeden, A. M., Baltimore, Md.

SCIENTIFIC MISCELLANY.

THE ELECTRICAL EXHIBITION.

The International Exhibition now in progress at Philadelphia, under the auspices of the Franklin Institute of Pennsylvania, is the fourth of its kind, the three preceding having been those of Paris, Munich, and Berlin. All four have been held within as many consecutive years, and the reflection may occur that they are succeeding each other with too great rapidity. Yet when we observe the remarkable progress made almost from day to day in the utilization of electrical force, it becomes obvious that even the developments of a single twelve months may deserve to be gathered up and displayed in a new exposition. One of the most striking thoughts occurring to the visitor in Philadelphia is that whereas ten years ago the magnetic telegraph, that wonder of our age, would necessarily have been the central and all-absorbing feature of an electrical fair, now it is relegated to a modest corner, not for purposes of display, but to fulfill the same matter-of-fact functions that it might in a political convention or a dog show. It is the uses of electricity as a light, a motor, and a conductor of sound that now claim the chief place of honor and of interest.

The Exhibition was opened on the 3d of September—to continue until the 11th of October—with appropriate ceremonies, in the presence of a vast throng, which included many guests distinguished in diplomacy or in science. It is held in a new and spacious building, constructed for the purpose, at the corner of Lancaster Avenue and Thirty-second Street, close by the old Pennsylvania Railroad station. This latter is connected with it as an annex, and furnishes not only a fine concert hall and lecture room, but also additional area for electric railway switch and signal exhibits, and others that require much space. The spot is not far from the one on which Franklin, one hundred and thirty-two years ago, drew the electric fire from the sky along his kite string.

Despite many evidences of incompleteness at the outset, this exhibition will be a worthy successor to the finest that has gone before it. All the dynamos and electric light and telephone systems familiar to the American public—the Edison, the Thompson-Houston, the United States, the Brush, the Bell, the Bernstein, the Excelsior, the Acme, the McTighe, the Weston, and so on—are there in their familiar manifestations. Here may be seen Edison's gigantic machine, the largest dynamo in the world, the thirty ton "Jumbo," seven feet in height, nine in width, and fifteen in length, challenging the old-time supremacy of steam, as represented in the great Porter & Allen engine that furnishes power for a myriad of minor machines and wheels through the building. A dozen or more powerful dynamos and many steam-engines are met from point to point. Here are the Thompson-Houston devices for conveniently combining the arc and incandescent

system. Here is the joint exhibit of the Ordnance Corps and Signal Service of the army, with its electric self-recording rain gauge, its model of a field telegraph train and portable field telegraph apparatus, its instruments for measuring the force and direction of the wind and the velocity of projectilies, and for determining barometric pressure, besides the familiar system of signaling.

Hard by is the Navy Department's exhibit, which includes torpedoes fired by electricity and others exploded by contact; electrical appliances for firing guns separately or in broadside; a pair of revolving naval search lights operated by Gramme dynamos; electrical appliances for determining water currents or electric currents; devices for exploding torpedoes in boats, and the ingenious McEvoy apparatus for controlling a group of torpedoes from a common centre, and above all, for ascertaining the presence of hostile torpedoes by a telephonic detector sunk under the water, and communicating the news of their proximity to the patrolling boat by a peculiar low sound. In one of the towers is a great electric naval search light, perhaps the most powerful in the country, throwing its ray, by means of lenses and reflectors, over the city for a distance of more than two miles.

Fire alarms and burglar alarms of many kinds—matting with electric wires that can be put under carpets; wires and bells that connect with doors, windows, and safes; telephones in their now familiar guise, one of them communicating even with Boston; photometers and telemeters; locomotive head-lights; arcand incandescent lamps of all varieties; electric clocks and electric apparatus for minutely subdividing time—these are encountered on every hand. The applications of electricity to medicine, dentistry, and surgery find a place, as does educational apparatus for the school room. There are the marvels also of the phonograph, the microphone, and various devices used thus far mainly for entertainment. The telegraph, too, has its share of attention after all in the exhibition of its multiplex system, which allows scores of messages to be sent simultaneously over the same wire without the slightest interference or betrayal of each other—a most useful invention in these days when the multitude of wires required under the old system would be appalling.

Electro-plating, lightning-rods with their copper wires and platinum tips, the application of electricity to mining and blasting, and other familiar matters are not neglected here. Groups of sewing-machines are at work on leather or on cloth by the aid of electricity, and some of those who sew are merely doing on exhibition what they have done in their own workshops for months. There is a great case full of eggs, from which chickens are to be hatched by electricity. Storage batteries of various sorts and exhibits of electrical supplies are found, and many small dynamos seem adapted to almost any form of light sedentary labor performed by man. A great variety of globes and chandeliers is shown, and upholsterers and other tradesmen have taken advantage of this fact, it must be confessed, to make displays of very beautiful wares, which no one would like to miss seeing, though thier connection with the purpose of the exhibition seems to be merely that of demonstrating that goods of their quality light up admirably

under the electric light. In a few other instances the connection of exhibits with the central purpose of the fair may be even more obscure; still the display of gas-lighting apparatus can at least be regarded as a useful foil to electric illumination, while that of gas engines may be designed to shown that gas has yet new missions in prospect.

The literature of electricity is represented by a large collection of books, which will pass into the possession of the Franklin Institute at the close of the fair. Great maps hung on the walls of the lecture-room show the lines of sea cable, present and prospective. The history of electrical appliances is set forth by exhibits of old-fashioned voltaic piles, an electric machine constructed by Franklin, the famous instrument of Morse, and so on; and certainly one of the most striking portions of the whole display is the contribution by the United States Patent-office of the original models on which patents were granted to the most famous of existing American electric devices.

For spectacular effect, night, when all the multitudinous flames of this palace of light, both within and without the building, are flashing, is the time most favorable. Within, disposed at all available points, hanging from girders and arranged in rows along the thirteen arched rafters of the main building, are no fewer than 5,600 incandescent lights and 350 arc lights. Of the former, 1,200 are contributed by the United States Company and 3,800 by the Edison, other companies furnishing the remainder. The dazzling noonday splendor of this illumination is enhanced by a large fountain in the centre, which throws an upward jet from a mass of stone, against which shoot other great jets from the rim of the basin. The spray, illuminated by the surrounding lights, transmitted through glasses of different colors, reflects prismatic hues at every point, and falls in a perpetual shower of jewels. Beds of flowers around the basin add to the effect, as do the other decorations of the hall. While the eye is thus gratified, the electric organ attracts the ear from its position in the gallery, the key-board with which the performer plays it being on the main floor, a hundred feet below.

From an exhibition so largely devoted to practical mechanism, occupying 200,000 square feet of space, and actuated by steam-engines aggregating 1,800 horse-power, not only pleasure but scientific profit should be expected. There are about 250 separate exhibitors, and from six to eight times that number of exhibits. These cover a very wide range of electrical application, and the committees who are to examine and report upon them are mostly well-known experts, who will doubtless put them to a thorough test.—*Harper's Weekly*.

RECENTLY PATENTED IMPROVEMENTS.

J. C. HIGDON, M. E., KANSAS CITY, MO.

MANUFACTURE OF SEPARABLE LAP-LINKS.—This invention relates to improvements in that article of utility commonly known as a lap-link, and to the manner of attaching it to the single-tree of a vehicle.

It consists of two circular or eliptical rings of metal, each so stamped or cut from a sheet of iron as to leave an opening through which a trace-hook or similar instrument may be passed; the pair being united at a suitable point of tbeir circumference, by means of a strong rivet or bolt.

The said lap-link is preferably constructed by first stamping or cutting the thin, flat links directly from a sheet of metal and afterwards forming, at corresponding points in their circumference, the apertures for the reception of the rivets.

When it is desired to use a link in connection with a single-tree, a pair of the links are inserted between clamping-lugs upon the outside of a revolving ferrule where they are securely held in place by means of a heavy bolt or rivet.

The said revolving ferrule is attached to the end of the single-tree through the medium of a flanged ferrule and a screw-bolt. Such an arrangement permits the outside ferrule to revolve freely, hence the single-tree may be quickly and easily reversed.

The link and its connections may be constructed of malleable iron and it is preferable to make the outside and inside ferrules in that manner, but the link should be formed as before described.

When the two thin links are united by a small rivet, they may be used in connection with a common clevis, for coupling together the different parts of vehicle pulling-gear, and for many other useful purposes, such as forming a complete chain. The inventor is Mr. J. H. C. Wilkening, of Higginsville, Mo.

COMBINED BELT-GUIDE AND REEL.—The object of this invention is to provide a simple and efficient guiding device for the driving-belts of threshing-machines and similar apparatus, in such a manner that very little wear will be produced upon the edges of the belt, even when the same is being operated against a heavy side wind.

The device consists of a suitably sized hub that is journaled horizontally to the frame work of a machine, preferably by means of a tri-armed hanger or bracket, and carrying upon its outer extremities, or cast integral therewith, a pair of vertical guiding-discs between which the belt is adapted to run and be guided in its course toward the pulley of the machine.

The invention consists further in providing the said belt-guiding device with an aperture in each disc thereof for inserting a pin above the belt, so that when the belt is not in use and the device is revolved, by means of a removable handle, the belt may be wound thereon. as hereinafter more fully set forth.

Heretofore the edges of a belt have been rapidly worn away by reason of improperly constructed guiding pulleys, for the reason that the surface presented to the edge of the belt was quite angular and abrupt.

In this apparatus the guiding-pulley or reel is preferably constructed of cast-iron, in two similar sections or discs, the hub being cast integral therewith, and fitted to a journal projecting from a tri-armed hanger or bracket which is bolted to the machine framing. A removable handle is adapted to be inserted in an

aperture provided for that purpose near the periphery of the outer disc so that by inserting a pin through corresponding apertures in each disc and above the lower line of the belt, the same may be coiled by hand upon the hub of the device and thereby be protected from the weather, and at the same time be easy of access when occasion requires.

The driving-pulley of the machine is placed somewhat above the plane of the guiding-pulley so that both lines of the belt will be situated above the guiding-pulley journal. But it is not necessary, however, that both lines of belt should run within the diameter of the discs; on the contrary it is preferable that the upper line operate entirely above the guiding-pulley. This invention was recently patented by Mr. F. B. Ray, of Kansas City, Mo.

EDITORIAL NOTES.

THROUGH the courtesy of Mr. J. S. Chase of this city, now visiting in Dakota Territory, we have received a photographic representation of a tornado-cloud taken by Mr. F. N. Robinson, of Howard, Miner Co., D. T., August 28, 1884. The storm passed twenty-two miles west of that place at 4 P. M., moving in a southeasterly direction and remaining in sight more than two hours. It was very destructive, killing several people and destroying all property lying in its track. As a work of art this photograph is admirable, since the details of shape of the funnel and the light and dark shades of the cloud are as distinctly brought out as though the object had been a fixed one in the operator's room; while as an object of interest and information to the meteorologist nothing so satisfactory has ever come within our notice. We consider that Mr. Robinson is entitled to the thanks of all scientific men for his enterprise in this matter.

THE Fish Commission of Missouri has just published a small book of sixty-four pages, on Carp Culture, with an appendix of Native fish. It will be sent to residents of Missouri, free of charge, on application and enclosure of three cents in postage stamps. Apply to Phil. Kopplin, Jr., Forest Park, St. Louis.

PROF. A. S. GATSCHET, the noted anthropologist of the Smithsonian Institution passed through this city on the 21st of August on his way to New Mexico and Colorado. It is a matter of real regret that we were out of town when he called at the office of the REVIEW.

BY invitation of the authorities of the Johns Hopkins University, Sir Wm. Thomson, D. C. L., F. R. S., L. & E., etc., Professor of Physics in the University of Glasgow, will deliver in this month a course of eighteen lectures on "Molecular Dynamics," before the Physical section of the Johns Hopkins University. The opening lecture will be given on Wednesday, October 1st, at 5:00 P. M. The other lectures will follow on consecutive days at the same hour. Professors and students of physics are invited to attend, and arrangements will be made by which they may easily obtain temporary lodgings, provided an early intimation is received of their intention to come.

ITEMS FROM PERIODICALS.

THE *North American Review* for Octotber is notable as well for the importance of the topics treated, as for the eminence of its writers. The leading article, "Moral Char-

acter in Politics", is by President J. H. Seelye, whose exposition of ethical principles involved in the popular election of candidates to high station in the Government must command the attention of every right-minded citizen. "Benefits of the Tariff System", a sequel to the article in the September number on the "Evils of the Tariff System", is a symposium consisting of three articles, written respectively by John Roach, Prof. R E. Thompson, and Nelson Dingley, Jr., who advocate the policy of protection of American industries with great clearness and ability and abundant citations of statistical facts. In addition to these most timely discussions of high political issues, the *Review* has an article by the Rev. Dr. Augustus Jessop, entitled "Why I Wish to Visit America"; "The Philosophy of Conversion" by O. B. Frothingham; "The Origin of Yellow Fever", by Dr. C. Creighton; "Shall the Jury System be Abolished?" by Judge Robert Y. Hayne; "The Genesis of Tennyson's Maud", by Richard Herne Shepherd; and "The Development of Machine Guns", by Lieut. C. Sleeman.

THE October *Harper's Monthly* contains as a frontispiece a charming picture by Mr. Abby of "Judith Shakespeare," the hereine of William Black's story, which nears its close, and has more of the delightful engravings from the pencil of Dielman and Gibson, illustrating E. P. Roe's "Nature's Serial Story," part eleven. Both Mr. Boughton and Mr. Abbey illustrate the instalment of the former's clever "Artist Strolls in Holland," which appears in the number. Horace E. Scudder takes the reader to Copenhagen, "The Home of Hans Christian Andersen," and Rufus F. Zogbaum to "The Home of Tommy Atkins," who is quite an other kind of person. Tommy Atkins is the popular name for the British soldier, and the home described is the great camp at Aldershot. Both of these papers are fully illustrated by the writer himself. A Mexican metropolis, Montercy, is described and illustrated in an article called "The Gateway to the Sierra Madre," by Frank R. Brown. Two historical papers, one on King's College (now Columbia), New York, by John MacMullen, and the second by Treadwell Walden, on Westminster Hall; and two biographical—one a reminiscence of Mr. Darwin, with a portrait of him in middle age, the other the remarkable story of a slave horse-jockery, Charles Stewart told by himself and edited by a Southern lady, are features of the number. One of miscellaneous papers, on "Municipal Finance," by W. M. Ivens, private secretary to Mayor Grace, of New York, will attract much attention, and there is the usual variety of stories, poems, and departments.

THE *Science Observer* of September 14th announces that a cable message was received on the 13th, at Harvard College Observatory, from Dr. Krueger, Kiel, announcing the discovery of a planet by Dr. Luther. The position given, September 12.379, Greenwich M. T., is the following: R. A. 0h. 12m. 4s. Decl. + 10° 37′. Eleventh magnitude.

THE *Art Interchange* of September 11th contains a charming design in color of a vase decorated with pink morning-glories. The addition of bronze to this design makes it most exquisite for decoration in mineral colors. The same issue also contains a beautiful picture of a girl in frilled cap, which suggests the Cherry Ripe of Millais. Price per copy, 15 cents. Published by William Whitlock, 140 Nassau Street.

THE *Popular Science Monthly* for October is the closing number of the 25th volume and is in full accordance with the ideal purpose of its origination. The object of the magazine has been to bring forward distinctively and prominently the higher human aspects of human inquiry, and every one of the fifteen articles of the present number sustains this character. The first paper, by Dr. F. J. Shepherd, on "The Significance of Human Anomalies," is an illustrated and very timely exposition of those aberrations of structure in the human sys-

tem, which for centuries were the puzzle of anatomists, but which are now claimed to be cleared up by the doctrine of descent and evolution. Francis Galton's paper on the "Measurement of Character" is a skillful and most suggestive attempt to bring the higher human characteristics within the pale of quantitative science. Lord Rayleigh's survey of "The Recent Progress of Physical Science," which was his presidential address before the Montreal meeting of the British Association, is given in full, as it deserves to be, though elsewhere it appears only in abstacts. A biographical sketch and fine portrait of Lord Rayleigh are also given. "Diet for the Gouty," in Professor William's series on "The Chemistry of Coockery," "Wages, Capital, and Rich Men," "Physiological Aspect of Mesmerism," "The Morality of Happiness" (conclusion), "Protection against Lightning," "The Cholera-Germ," and "The Origin of Cultivated plants," are all fresh, readable, and valuable papers. Professor J. P. Cooke contributes "Further remarks on the Greek Question," and the editor keeps up his fight with the classicists for more room and higher consideration for science in education.

Subscribers to the REVIEW *can be furnished through this office with all the best magazines of this Country and Europe, at a discount of from* 15 *to* 20 *per cent off the retail price.*

THE October *Atlantic* contains several articles which will appeal to widely different classes of readers, Dr. Weir Mitchell continues his excellent story, "In War Time;" Francis Parkman, the distinguished historian of Colonial America, writes of the "Battle of Lake George;" Elizabeth Robins Pennell discusses the "Relation of Fairies to Religion;" Louise Imogen Guiney praises Leigh Hunt, whom she styles "An English Literary Cousin;" Bradford Torrey, who has recently contributed several admirable articles about birds, this time describes various "Minor Songster;" George Houghton has an article entitled "Washington and his Companions viewed Face to Face;" J. Howard Corbyn furnishes the short story of the number, "Buckshot: A Record." The classical article of the number is by William Shields Liscomb, on "The Migrations of the Gods;" Margaret Bertha Wright gives an account of a French "Bourgeois Family;" Charles Foster Smith writes of "Southern Colleges and Schools;" Edith M. Thomas contributes a charming short article on "The Solitary Bee;" and an anonymous writer, but evidently one who wields a practical pen, writes a second article on "The Lakes of Upper Italy." There are poems by Oliver Wendell Holmes, Cecil Thaxter, and Augustus M. Lord. A review of several important new books and the usual collection of bright short essays in the Conbributors' Club, with an account of the Books of the Month, complete another substantial number of this sterling monthly. Houghton, Mifflin & Co., Publishers, Boston.

To any person remitting to us the annual subscription price of any three of the prominent literary or scientific magazines of the United States, we will promptly furnish the same, and the KANSAS CITY REVIEW, *besides, without additional cost, for one year.*

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"Kansas City Review of Science and Industry,"

ADDRESS

THEO. S. CASE,

Editor and Publisher.